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NORTH CAROLINA GEOLOGY, AND
MINERAL RESOURCES

UNDER THE ACT OF MARCH 3, 1879.

BULLETIN NO. 17

HISTORY OF THE GEMS FOUND IN
NORTH CAROLINA

BY
JAMES H. HARRIS, GEOLOGIST.



Published by the
U. S. GEOLOGICAL SURVEY, WASHINGTON, D. C.
1900



**HISTORY OF THE GEMS FOUND IN
NORTH CAROLINA**

BY

GEORGE FREDERICK KUNZ, Ph.D.

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**NORTH CAROLINA GEOLOGICAL AND
ECONOMIC SURVEY**

JOSEPH HYDE PRATT, STATE GEOLOGIST

BULLETIN NO. 12

**HISTORY OF THE GEMS FOUND IN
NORTH CAROLINA**

**BY
GEORGE FREDERICK KUNZ, PH.D.**



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LETTER OF TRANSMITTAL

CHAPEL HILL, N. C., November 15, 1906.

To His Excellency, HON. R. B. GLENN,

Governor of North Carolina.

Sir.—I have the honor to submit for publication as Bulletin No. 12 of the Geological and Economic Survey, the report of Dr. George Frederick Kunz on the History of the Gems found in North Carolina.

Yours obediently,

JOSEPH HYDE PRATT,
State Geologist.

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PREFACE

The preparation of the report on the History of the Gems Found in North Carolina was turned over to Dr. George Frederick Kunz of New York as the recognized authority on gems. He has had access to all the information relating to gems and gem minerals on file in the office of the Survey, and has also drawn freely from the various publications by himself and others relating to the gems of the State. In his introduction, Dr. Kunz calls attention to the fact that the production of gems in the State has been largely incidental to the mining and production of some other mineral and that there have been but few localities that have been developed solely for gems. At the present time, however, there are several companies operating in North Carolina simply for gem minerals, the two more important companies being the United States Ruby Company and the American Gem and Pearl Company.

The report is freely illustrated and many of the colored illustrations are of gems in the Morgan-Tiffany and Morgan-Bement collections at the American Museum of Natural History of New York City.

Chapter I gives a brief historical sketch of gem mining in the State, but detailed accounts are given in many instances under the head of the individual mineral.

The various gem minerals are described in the next five chapters. The localities are also given and reference is made to the commercial value of the gem material found.

This report does not pretend to take up a detailed account of the geological occurrences of the gem minerals, or a study of their chemical and physical characteristics, as these will be discussed in a later publication. It has been published especially for distribution at the Jamestown Exposition.

JOSEPH HYDE PRATT,
State Geologist.

INTRODUCTION

North Carolina, with its magnificent mountains and its swiftly running rivers and streams, has now for some years come to possess almost as great a charm for the Northern as it long before had for the Southern tourist. "The land of the Sky" has become a favorite resort for the traveler, the invalid, the sportsman, the lover of nature, and the seeker for rest, from almost every part of the country. For the mineralogist, too, it has peculiar interest, so great, indeed, that its scenic attractions have, for such as he, been almost overmatched, not to say overlooked, in the search for the beautiful crystals that are found in its mountains, and the variety of rare, minute, and interesting minerals that occur in the brooks and streams associated with gold. Among these crystals and sands occur many minerals that have yielded true gems, and North Carolina has hence become one of the most *notable* States for gem production in the American Union.

The finding of these minerals, however, has been in most cases a secondary or incidental result in the search for and mining of substances more immediately desired for practical use on a larger scale. These last have been essentially three, which have developed in succession, and mark several stages in the mineral production of North Carolina.

These stages were: (I) The gold-mining, from early in the last century to the time of the Civil War; (II) the corundum and mica industry, for the quarter-century following that great struggle; and (III) the development of the "rare earths," and the monazite sands, in connection with recent scientific discoveries and appliances, within the last 10 or 15 years. To these may be added a fourth stage, viz., that of systematic mining for the gems themselves at various times, such as for sapphire at Corundum Hill; for ruby and rhodolite in the Cowee Valley; for beryls in Mitchell County, and later, for amethyst at Tessentee Creek, Macon County.

Through the gold belt of the western Carolinas and Georgia, that metal occurs widely distributed, but in very variable amounts. At certain points mining has been conducted with profit, and in some instances nuggets of impressive size have been obtained. More or less active working has long been done in the North Carolina gold fields, and the

total product has been very considerable; but, strange as it may seem, many of the discarded gold-washings of a century ago are now yielding more to the owner of the land for the obscure and long unknown monazite sands than for the gold originally obtained with them. In regard to this latest development, extended mining has recently shown that the hillsides, from which the monazite sands in the "branches" and streams originally came, contain an endless store of these rare minerals, and that when the ancient brook-washings are exhausted, the hillsides can be resorted to for a century to come. It is in the search for this mineral that most of the small and beautiful garnets, rutiles, sapphires, epidotes, and other gems have lately been found.

Between the gold-mining of earlier times and the more recent and varied developments, came the terrible years of the "war between the States." When that was past, brave and patriotic men like the late Gen. Thomas L. Clingman, afterwards United States Senator, turned their attention to developing the natural resources of their State and retrieving in every way possible the ruin and devastation that had swept over the South. Then commenced a period of exploration and discovery in the mineral and gem treasures of North Carolina that has progressed and expanded to a wonderful extent. It began with the corundum industry and the mica mines. The presence of the former mineral had been known for some years before the war, but it had not been developed. The first notice of its occurrence in the State was in 1846, by Prof. C. D. Smith, but with no particulars as to the locality. About 1850 General Clingman announced it from Madison County; and in 1852, Prof. R. T. Brumby, of the College of South Carolina, collected and labelled specimens from Clubb Mountain, in Lincoln County, and placed them in the College cabinet at Columbia, S. C. In the next year Professor Ebenezer Emmons, of the University of North Carolina, in a report on the midland counties of the State, mentioned a discovery of corundum by Dr. C. L. Hunter, in Gaston County. Little or nothing was done in regard to it, however, until immediately after the war, in 1865, when the Rev. C. D. Smith, of Franklin, Macon County, who had been an assistant to Prof. Ebenezer Emmons on the Geological Survey of the State, identified specimens that were brought to him, visited the spot whence they came, and discovered a number of important localities. In the next 5 years a great amount of exploration was done, mines were opened, and an important and enduring industry was called into being. Among those most active in this field of study and progress, besides Mr. Smith and General Clingman, were the able State Geologist, Prof. Washington C. Kerr, the enthusiastic and indefatigable collector, Mr. J. Adlai D. Stephenson, of Statesville, and

Mr. C. W. Jenks, who opened the Corundum Hill mine, at Franklin, N. C., about 1870, and was the first to find gem sapphire in its original matrix. During the same period, numerous valuable scientific reports and analyses were prepared and published by such authorities as Prof. F. A. Genth, Dr. J. Lawrence Smith, and Dr. T. M. Chatard; and the North Carolina corundum, its history, mineralogy, and composition, was thus made widely known.

Although the main value of the mineral as mined was for use as an abrasive material, yet pieces were obtained that had color and transparency enough to rank them in some cases as true gems and largely as valuable specimens. Among the first fine crystals were some obtained by Prof. C. U. Shepard; one of these, now in the Shepard collection at Amherst College, Mass., weighs over 300 pounds. Besides the collecting tours of Professor Shepard, many annual visits were made to the corundum region by Mr. Norman Spang, of Pittsburg, Pa., a wealthy and noted collector, who encouraged exploration, and brought back with him much of the choicest of the "treasure trove." Mr. W. E. Hidden, of New York, devoted a large part of 20 years to energetic and intelligent search for minerals and gems with wonderful success; and recently the State Geologist, Dr. Joseph H. Pratt, and Prof. J. V. Lewis have given extended and detailed study to the whole subject of the various occurrences of corundum in the State. All this activity has not only developed the industry itself, but has led incidentally to other discoveries. It may be, indeed, that more has been spent in the search and in attempts at mining, not always judicious, than the product itself has yielded; but the effect on the development of the State has been immense. In the matter of gems and remarkable specimens, these years of exploration have successively brought to light one and another fine gem, crystal, or rare mineral, to such an extent that to-day, were the North Carolina specimens removed from the great collections of the world, a gap would be left that could not be filled, in such places as the American Museum of Natural History, New York, the British Museum of London, the Imperial Museum of Vienna, the U. S. National Museum at Washington, the Field Columbian Museum of Chicago, the Musée de Historie Naturelle, Paris; and many others, important but less famous.

During the same general period, the mining of mica came to be another important industry in the revival of the State, and this also led to discoveries of other rare minerals in the search for valuable localities for mica. One of the most curious and interesting facts brought to light in this connection, was the clear evidence that some of the best mica mines had been long and extensively worked by ancient aborigines, either Indians

or earlier "mound-builders" (if these indeed be distinct peoples), or both. Ornaments cut from mica, as also shells and quartz crystals, are not uncommon in the burial-mounds of the Mississippi valley; and, as no mica occurs in that part of the country, it is clear that the old excavations, rudely made with stone tools, along the outcrops of large mica veins in North Carolina, were the source of this material, which was evidently prized by the prehistoric tribes and widely distributed among them.

It is a "far cry" from prehistoric mounds and ancient and long-forgotten mica mines to the incandescent lighting of our present civilization and the properties of rare chemical elements. But such are some of the contrasts that present themselves in speaking of North Carolina minerals. It is now some 18 years since the introduction of the Welsbach incandescent burner, or rather mantle, that has so improved our gas illumination. Instead of using the light produced by white hot carbon particles, as in ordinary flame, a hood or mantle is employed, which, when heated by the burning gas, glows with far greater intensity. This mantle consists of a loosely woven fabric impregnated with certain compounds of rare elements. The first forms of it employed zirconia salts; and this fact led to active mining of the small, opaque, and previously unimportant zircon crystals that are abundant at several points in North Carolina. Since then it has been found that even greater brilliancy is obtained by the use of nitrate of thorium. This latter is a rare metal, found in very few minerals and in small amounts; but it is notably present in monazite, a phosphate of this and other oxides of rare elements. Monazite was formerly regarded as a very uncommon mineral, but it has been found to occur quite abundantly in the sands of the stream-beds in the South Mountain region, comprising several counties of North Carolina, being derived from the disintegration of the country rock. Thus the monazite industry has now become highly important, and it is likely to continue and increase; as the demand for thorium salts for incandescent burners is very great. This latest stage of North Carolina mining—the search for the "rare earths," so-called—has developed extensively within a few years; though General Clingman was active in the earlier stages of it, in promoting the zircon mining, and Mr. W. E. Hidden first brought into use the monazite sands, and induced the Welsbach Company to experiment with them in 1884. In 1901 the monazite output of North Carolina was 748,000 pounds, valued at some \$50,000. Only Brazil surpasses, or even approaches, this production. In 1906 the output was 697,275 pounds, valued at \$125,510. A total of 8,426,004 pounds valued at \$635,568, was mined in the 14 years 1893 to 1906, inclusive.

With these general historical outlines in mind, we may pass to a more

special account of North Carolina gems, that have been found, as above noted, chiefly as incidents in the course of mining enterprises.

The diamonds of North Carolina, although small in size and few in number, are undoubtedly authentic. The localities have been visited and the discoveries verified by good mineralogists. Whether their occurrence will always be as sporadic as these, or whether others will be found, time only can tell. Rubies, as fine in color as those of Burma, but generally small or containing imperfections, have lately been found in the Cowee Valley, in Macon County; considerable mining for them has been done, but the financial outcome is still somewhat problematical. Emeralds, remarkable as crystals, but rarely transparent enough for gems, were obtained in Alexander County, some years ago; but a greater quantity has been sold from the more recent Crabtree Mountain discovery, in Mitchell County, where the emerald is translucent to transparent, in a white granitic rock, and the whole is cut together as a matrix material—the quartz and feldspar contrasting charmingly with the emerald green. Aquamarines, which for beauty of colors have never been rivalled in any country of the world, have been found in some profusion, and many gems have been cut weighing from 1 to 30 carats, of the most beautiful sea-blue color. Beryls, both sea-green and yellow, than which none richer have ever been found, are also obtained in Mitchell County and elsewhere. Mention should also be made of the peculiar “lithia emerald,” or hiddenite, found with the large emerald crystals above noted, at Stony Point, Alexander County. This gem-stone was discovered in 1879 by J. Adlai D. Stephenson, then sent by William E. Hidden to Dr. J. Lawrence Smith of Louisville, who named it *hiddenite*. The garnets of the gold washings are well known; but it remained for the Cowee Valley to produce a new variety of garnet which has received a distinct name, *rhodolite*, and has brought of late greater financial returns, probably, than any other North Carolina gem. The amethysts from various localities equal those found in any country of the globe; while smoky quartz, wonderful as crystals, that have commanded the attention and study of some of the greatest living crystallographers, has been obtained in Alexander and adjoining counties. These specimens have frequently been fine enough to cut into gems. But quartz in its choicest form,—rock crystal—has been found in Ashe County in such magnificent masses that one of the finest art objects shown at the Paris Exposition of 1900, was made from rock crystal obtained in this county in 1888 by the author as was the cover of the “Adams gold vase” presented to the same museum. These now form parts of the Matthiessen gift and Edward D. Adams gift to the Metropolitan Museum of Art, in New York, where they are two of the finest objects in the entire museum.

It is intended in this report to illustrate some of the principal North Carolina gems, more remarkable usually as crystals than as precious stones for jewelry, that grace the great collections before alluded to. All those shown on the colored plates, and many of the others, are contained especially in the Morgan-Tiffany collections, presented by the munificence of Mr. J. Pierpont Morgan to the American Museum of Natural History, at New York; these comprise the splendid collections formed by the author for Tiffany & Company, of New York, of American gems and precious stones shown at the Paris Exposition of 1889, and the still finer and more extensive one displayed by them at the Paris Exposition of 1900; also the Tiffany collection shown at the Cotton States Exposition at Atlanta, in 1894, and presented to the U. S. National Museum by Prof. L. T. Chamberlin.

Many of the figures are loaned by the courtesy of the publishers of "Gems and Precious Stones of North America," and will form part of the new edition of that work, treating of the Morgan-Tiffany and Morgan-Bement collections of minerals in the American Museum of Natural History; this latter made up of the Spang collection and many from the Hidden, Wilcox, and other collections. It was thought well to illustrate for this report specimens in places which are readily accessible, and no collection on this continent contains so many choice examples of North Carolina gems as does this one.

Fuller discussions upon all these subjects, with geological, mineralogical, chemical, or crystallographic details, may be found in the reports issued by the North Carolina Geological Survey, which contains many most valuable papers and monographs by such authorities as Kerr, Shepard, Genth, Chatard, Hidden, Lewis, and Pratt, and in the Journal of the Elisha Mitchell Scientific Society, published at Chapel Hill; also in the Annual Reports of the Department of Mining Statistics of the United States Geological Survey, prepared by the author under the directorship first of Albert Williams, Jr., and then of Dr. David T. Day, who has done everything to encourage and increase public interest in the development of the precious stone and mineral resources of the United States. Many papers have likewise appeared on the same topics in the American Journal of Science. Among all these, much of the literature of the gem product of the State may be found. It is the purpose of the present report to present in a clear and concise manner such facts as may interest the mineralogist, the collector, or even the tourist who wishes to acquaint himself with these "crystallized flowers," as the celebrated Abbe Haüy called them, whose enduring beauty remains unchanged by the variations of climate found upon our globe.

The mineral collections in the State Museum at Raleigh include a number of valuable and interesting collections of gems and gem minerals prominent among which is that of Mr. J. A. D. Stephenson, for more than 30 years a resident of North Carolina and an enthusiastic explorer of its natural resources.

Much credit is also due to the late James D. Yerrington, for many years the agent of the Henry D. Morse Diamond-Cutting Company, who for 30 years carried on correspondence with North Carolina, doing much by his kindly advice and care to encourage the people to send small gems, which in many cases led to valuable results.

GEORGE FREDERICK KUNZ.



A
Section of a sapphire crystal,
banded blue and yellow. Jenks Mine, Macon County,
North Carolina.



B
Asteriated sapphire.
Jackson County,
North Carolina



C
Ruby,
Jenks Mine, Macon County,
North Carolina



D
First sapphire found in matrix
Conardum Hill, Macon County,
North Carolina
Restored to matrix after being cut



E
Sapphire (Brown
Chatoyant,
McDowell County,
North Carolina



F
Ruby,
Cowee Valley,
Macon County, North Carolina



G
Ruby,
Cowee Valley,
Macon County, North Carolina

HISTORY OF THE GEMS FOUND IN NORTH CAROLINA.

By GEORGE FREDERICK KUNZ, PH. D.

CHAPTER I.

HISTORICAL SKETCH OF GEM MINING.

Gem mining in North Carolina had its origin; first, in the finding of rolled crystals in the gold washings in several counties, some of them of gem value, notably a few diamonds and occasionally a zircon or epidote; then in the development of the mica mines, some of which furnished some very beautiful beryls and others, garnets. Some of the garnet crystals of wonderful color and brilliancy were frequently found flattened between the plates of mica.

The first systematic mining for gems was undertaken by Mr. C. W. Jenks, in 1871, when he opened the corundum mine, on Corundum Hill, near Franklin, Macon County. This proved interesting scientifically, and many choice gems were obtained; and the name of the Jenks, or Culsagee, mine became noted. The amount of gems found, however, did not warrant permanent operations for gem corundum only, and after a few years the mine was operated for corundum for abrasive purposes. Another promising mine, opened soon afterwards, was the Buck Creek, or Cullakeenee mine, in Clay County; but this has had much the same history. Next came the mining for emeralds in Alexander County, at Stony Point, where crystals had been found loose in the soil formed by the disintegration of the country rock. As this region has never been subjected to glacial action, as the northern part of the country has, anything found in the soil, apart from stream-beds, has its origin presumably near the spot where it is met with. The entire soil and upper portions of the rocks here consist of what Professor Kerr called the "frost drift," *i. e.*, the same as the underlying rock, but decayed and decomposed by frost and weathering in general. Credit should be given here to the late Mr. J. Adlai D. Stephenson, of Statesville, who recognized these conditions and stimulated the country people to search the surface of their fields for such crystals, of

which he gathered a great collection, in the hope of locating mines near the points where anything of special interest was encountered. It was thus that the emerald locality at Stony Point, which also yielded the new and remarkable hiddenite gems, was traced. Later, the beryl mine at Spruce Pine, Mitchell County (Pl. II), was opened, and worked from time to time, affording beautiful beryls. Then came the discovery of true rubies near Franklin, Macon County, which has led to considerable development and to the finding of some crystals which had gem value, although never very great. Near this place occurs also the rhodolite—a garnet between pyrope and almandite. This has been developed by two companies with remarkable success, and apparently more gems in value have been sold from this mine than from all other sources in North Carolina combined. More recent still is the development of the emerald matrix mine at Crabtree Mountain, near Bakersville, in Mitchell County. Here the emerald occurs as small richly colored crystals, thickly strewn through a white matrix of feldspar and quartz; and the whole rock is cut and polished together, as a green and white ornamental stone, which is quite in favor. Amethyst of good quality, but not to any great extent, has been developed in Lincoln and Macon counties.

Thus far, with the exception of rhodolite and beryl, the gem mines of North Carolina have not proved remunerative enough to warrant a continued development, either from absence of sufficiently rich material or else from the use of methods that lacked cohesiveness to assure success.

A few notes may be given here as to some of the circumstances connected with mining development and the men who were active in it. General Clingman has been referred to already; another early and very active worker was Mr. C. W. Jenks, who will be mentioned further in relation to the first corundum development. One of the most energetic explorers and discoverers of North Carolina minerals was Mr. J. A. D. Stephenson, of Statesville. In 1888 he prepared for the author a summary of the results which he had attained in the years following the Civil War; and from this little unpublished work the following passages are taken, to show the spirit and the methods of his activity:

The Piedmont region lying between the Catawba and Yadkin rivers, is remarkable for the number of minerals, both common and rare, that are found in unusually fine crystals. Being a native of this section, and an ardent admirer of all the phenomena and beauties of nature, these crystals attracted my attention in early life, and the collection and study of them . . . convinced me that they were of more than usual interest; and my early experience in the placer gold mines of North Carolina familiarized me with the occurrence of such rare materials as monazite, xenotime, zircon, columbite, etc., in this region; and knowing that these materials are found



WISEMAN BERYL MINE, MITCHELL COUNTY, N. C., 18 MILES FROM MARION.

associated with precious stones in other countries, impressed me with the idea that by systematic search, valuable gems would be found here, but want of time and opportunity delayed the search until 1874.

I selected this section as the most convenient for my work. But the same indications cross the State from northeast to southeast. In fact, to draw a line from Paris, Maine, to Gainesville, Ga., it is surprising to me how near it passes all the gem localities east of the Mississippi River.

My plan was to go among the people of the country, and endeavor to interest them in collecting the different crystals found in their respective sections; this I found an easy matter, especially with the children, as they took hold of the idea readily and many of them soon became familiar with the work, and not only did good service in developing the mineral resources of the State, but many of them have acquired a good knowledge of mineralogy and general natural history.

Mr. Stephenson's discoveries form almost the only exception to the general statement made at the outset, that the discoveries of gems and gem-minerals in North Carolina arose incidentally in the search or mining for gold, corundum, mica, or the rare earths. Mr. Stephenson had described how he set about the search for gems directly, in the assurance that they must exist and could be traced by sufficient endeavor. In almost all other cases, the discoveries have been made accidentally in the course of other mining operations.

A recent letter to the writer from Mr. D. A. Bowman, of Bakersville, for example, states the usual facts as follows:

As to the discovery of beryl, and other gems, this was invariably by mica mining, for outside of a mica vein, I have never known a beryl to be found. In working for black mica, the beautiful beryl at Buchanan Mine was found. It was the same at Grassy Creek, where Wiseman and McKinney found the deep green aquamarines, and then sold to the "American Gem Company."

I identified the beryl found by Wiseman and McKinney and shipped it to Tiffany & Company.

It was Mr. Rorison and myself that first discovered the emerald matrix at Brush Creek Mountain, in 1894 or 1895. For 35 years I have worked hard to bring to light the various minerals and gems, and through your kind assistance I feel I have not worked in vain, and have been of some little service to my country.

In the same letter, Mr. Bowman gives an interesting account of the first opening of a mica mine, shortly before the war. In 1858, General Clingman, while traveling in the western part of the State, stopped over night with a Mr. Silver, near Bakersville, and was interested to find a window filled with 8 by 10 inch panes cut from sheets of mica, or as it was generally called, isinglass. The very next day, having been shown the spot where this novel material was found, General Clingman hired workmen and began sinking a shaft. Mica was taken out in magnificent

blocks; but General Clingman was more interested in a brilliant pyrites in the adjacent feldspar, under the impression that it was a silver ore. After the war had closed, in 1869, the old mine, long known in the vicinity as the "Sink-hole," was brought to the notice of a stove company in Knoxville, Tenn., who began to operate it for the mica, with great success. Another mica mine in the same section, the "Cloudland," was discovered accidentally at about the same time, and proved to be also valuable. Quite a local excitement sprang up, and much prospecting was done for mica, with the result that several important mines were discovered. One of these, the "Clarissa," has yielded as much as half a million of dollars, by Mr. Bowman's estimate. It has been worked down to 400 feet, and is now stopped by water; but only awaits improved machinery and a rise in the price of mica, to be reopened with profit.

With all that has been discovered, however, and all that has been done, in North Carolina gems, there are evidently much greater possibilities in the future. One suggestion of a practical kind may be made in closing this introductory chapter.

A wonderful development has gone on in North Carolina in the direction of the great hotels at Asheville and Toxaway and the mountain resorts at Linville, Cranberry and elsewhere, and a large tourist class visit this region every year. If some of the native prospectors should use their spare moments as do those in Russia, they would gather, mine and then cut the rock crystals, smoky quartz, and other stones of the region, shaping them into ornamental forms, as the inhabitants of the Ural Mountains have done since the eighteenth century, when Catherine the Second sent two Italian lapidaries to educate them in the art. This might well prove a source of interest and profit to the people of the State.

CHAPTER II.

DIAMOND

The mining of gems in this State had its origin in the finding of rolled crystals of gem value in the gold washings. In these regions have been found crystals of diamond, either loose in the soil, or taken from the washings of auriferous gravel.¹ The portion of the State which has yielded these valuable substances is that known as the Piedmont region—a broad belt of country, as its name indicates, at the foot of the mountains, along the eastern base of the Blue Ridge. The rocks here are metamorphic and crystalline, with some Cambrian beds a little farther west. There runs throughout much of this region a belt or belts of itacolumite, the so-called “flexible sandstone,” which is also found in Brazil and in the Ural Mountains, and has frequently been supposed to be the matrix of diamond crystals. The presence of this peculiar rock and the occasional discovery of diamonds in adjacent districts have led to the idea that the itacolumite belt of North Carolina might prove to be a valuable diamantiferous region; but as yet no diamonds have actually been discovered there, and but few have been found in the loose débris of the crystalline beds. The late Prof. Frederick A. Genth, of the University of Pennsylvania, described² the occurrence of the 2 crystalline varieties of carbon in that State,—the graphite in beds interstratified with schist or gneiss; the diamond in the débris of such rocks, associated with gold, zircon, garnet, monazite, and other minerals, and after speaking of this occurrence in connection with rocks of identical age, as a very interesting circumstance, he says: “The diamond has not been observed in North Carolina in any more recent strata, and in the itacolumite regions no diamonds have ever been found, as in Brazil; from which it appears that the itacolumite of Brazil is either simply a quartzose mica slate of similar age with the North Carolina gneissoid rocks, or, if it be contemporary with the North Carolina itacolumite, the diamonds were not produced in the same, but came from the older rocks and were redeposited with the sands resulting from the reduction to powder of these, and are now found imbedded in the same, their hardness having prevented their destruction. Seven or 8 diamonds have thus been found. They occur distributed

¹ *Gems and Gem Mining in the South*, by Joseph Hyde Pratt; *The Southland*, Vol. I, No. 2, p. 4, 1901.

² *Mineral Resources of North Carolina*, p. 28, Philadelphia, 1871.

over a wide area of surface in the counties of Burke, Rutherford, Lincoln, Mecklenburg, and Franklin, and I have no doubt if a regular search were to be made for them, they would be more frequently found." To the counties named by Professor Genth, must now be added McDowell, and these all form, with the exception of Franklin, a group lying together in the line of the general drainage of the country, southeast of the Blue Ridge. Franklin County is far to the northeast of the others; and any diamonds occurring there must be derived from the disintegration of another belt of crystalline rocks, that traverses the eastern portion of the State, near Weldon, in Halifax County, or else have been transported for a long distance by streams.

Up to the present time there are about ten authentic occurrences of diamonds in North Carolina, besides several reported discoveries that are not entirely reliable.* One such instance was that of a quartz crystal found near Danbury, which was examined, and pronounced a (genuine) diamond, by the local jewelers, who valued it erroneously at some thousands of dollars.

The first specimen in order of time, was found in 1843, by Dr. F. M. Stephenson, at the ford of Brindletown Creek, in Burke County. It was an octahedral crystal, and was valued at \$100; but no particulars of it are on record. Another was found in the same neighborhood by Prof. George W. Featherstonhaugh, but there seems to be no account of its characters preserved. In 1845, a diamond of $1\frac{1}{2}$ carats, a distorted octahedron with curved faces, clear and flawless, though tinged with yellow, was found in the gold washings of J. D. Twitty's mine, in Rutherford County. It became the property of the late General T. L. Clingman, of Asheville, who for many years took great interest and did great service in developing the mineral resources of North Carolina. This stone was described by Prof. Charles U. Shepard,⁴ who announced the existence of itacolumite in the gold-bearing region of North Carolina, at the meeting of the American Association of Geologists and Naturalists in 1845, and under the impression that the itacolumite is their matrix, had predicted the further discovery of diamonds in that region, as in Brazil. For this reason diamonds, when found, were naturally submitted to him. C. Leventhorpe, of Patterson, Caldwell County, N. C., reports a small and poor specimen found in a placer mine on his property in Rutherford County, and states that he presented it to Prof. Shepard, who retained it in his cabinet. The next important diamond was found in gold-washings

* Sketch of N. C., issued by the Dept. of Agriculture, Raleigh, to accompany the State Exhibit at the Charleston Exposition, 1902. Diamond, pp. 40, 41.

⁴ Am. Jour. Sci., Vol. II, p. 253, Sept., 1846.

in 1852, by Dr. C. L. Hunter, near Cottage Home, Lincoln County. It is described as an elongated octahedron of a delicate greenish tint, transparent, and about half a carat in weight. Another, said to be a very handsome white crystal of 1 carat, was obtained in the same year, at Todd's Branch, Mecklenburg County; it became the property of the late Dr. Andrews, of Charlotte, N. C., who also informed Prof. Genth that a beautiful black stone "as large as a chinquapin" was afterwards found by some gold-washers in the same locality. This specimen, unfortunately, was crushed with a hammer, sharing the fate of several American diamonds when submitted to the mistaken test which confounds hardness with strength. The fragments of the black diamond scratched corundum with ease, thereby proving its genuineness.* Soon after this two diamonds, one a beautiful octahedron, were reported by Prof. F. A. Genth, as obtained at the Portis mine, in Franklin County. This locality is far removed from the others in North Carolina,—a point which is referred to presently.

Two discoveries are recorded in McDowell County, one of two or three small crystals found at the headwaters of Muddy Creek, and the other a fine stone picked up at a spring near Dysartville, in 1886.* This was a distorted and twinned hexoctahedron, of $4\frac{1}{2}$ carats, transparent, with a grayish-green tint. The little son of Mr. Grayson Christie, going for water to a spring on the farm of Alfred Bright, observed this peculiar shining pebble, and brought it home. After some local interest had developed, its nature was suspected, and it was sent to New York and there at once identified. A model of it was exhibited at the Paris Exposition of 1889, and is now in the Tiffany-Morgan collection of the American Museum of Natural History. The present writer subsequently visited the spot, and fully authenticated all the facts of the discovery. The sediment in the bed of the spring was taken out and examined, and also the small hollows on the adjacent hillside. None of the ordinary associations of the diamond were observed, and hence it is probable that the crystal was washed down with decomposing rock-soil from higher ground, perhaps during some freshet; or possibly it may have been carried to the spring by miners, and left unobserved or unrecognized among the "wash-up" of the gold-bearing sand from some neighboring placer. There are gold mines in McDowell County, worked chiefly by hydraulic sluicing, but as a rule the stones that remain in the sluices are carefully examined, as the miners know that gems are sometimes thus found. The value of the Dysartville diamond as a jewel will hardly represent the

* Handbook of North Carolina, Raleigh, 1886, pp. 197, 198.

* Am. Jour. Sci., Vol. XXXIV, Dec., 1887, p. 490.

interest that attaches to it as a local specimen of large size and fine appearance. (See Plate III.)

Another diamond is reported to have been found 9 years before, in 1877, by a small boy, in the same region as the last. It weighed $2\frac{3}{8}$ carats, and is described as white and lustrous, but somewhat flawed, and of irregular flattened form, resembling a bean, with the crystal faces obscure. The finder sold it in Marion for a mere nominal sum. Mr. B. B. Price, of Marion, put it for disposal into the hands of Mr. James M. Gere, of Spruce Pine, an extensive buyer and miner of North Carolina mica. He took it to Syracuse, N. Y., and sold it there to Messrs. C. M. Ball & Co., jewelers, for the sum of \$18. It was finally sent to New York, where it was cut into a small gem and its identity lost.*

Still another crystal is in the State Museum at Raleigh. The particulars of its discovery are not known; but it was purchased by the State with the collection of the late Dr. J. A. D. Stephenson, of Statesville, N. C., who had possessed it for some years, and reported that he had bought it, with other minerals, from a countryman in Burke County. It has an oblong spheroidal form, the faces being curved and rounded; and it weighs $\frac{5}{16}$ of a carat. These particulars are given in a recent letter from Mr. T. K. Brunner, Secretary of the State Department of Agriculture at Raleigh.

The latest well established discovery was in 1893, in Cleveland County, near King's Mountain. It was a polished octahedron, weighing $\frac{3}{4}$ carat, of a bright light canary yellow.

It will be noticed that most of these localities are situated in the same section of the State,—in the mountainous district, lying just north from the northernmost extension of the border of South Carolina. Here the counties of Burke, Rutherford, McDowell, and Cleveland lie closely adjacent, and Mecklenburg only a short distance eastward.

The foregoing list includes all the authentic diamonds thus far discovered in North Carolina. A number of small stones, exhibited as diamonds, have been found at Brackettstown. They are similar to supposed diamonds found by J. C. Mills at his mine at Brindletown, but these were transparent zircon or smoky-colored quartz, the former of which has a lustre readily mistaken by an inexperienced person for that of a diamond. A number of pieces of rough diamond, exhibited as from the same section, have been decided to be of South African, not Carolinian origin. It is to be hoped that the few legitimate discoveries

* Addendum to the "Minerals and Mineral Localities of North Carolina," by William Earl Hidden, p. 2, 1889; Reprinted from Jour. of the Elisha Mitchell Scientific Society, 6th year, part II. Raleigh, 1890.





A
Emerald,
Stony Point,
Alexander County,
North Carolina.

B
Aquamarine,
(Sea Green)
Spruce Pine,
Mitchell County,
North Carolina

G
Diamond,
Dysartville,
McDowell County,
North Carolina.

F
Hiddenite,
Stony Point,
Alexander County,
North Carolina.

C
Aquamarine (Blue)
Spruce Pine,
Mitchell County,
North Carolina

E
Beryl Cats Eye
Spruce Pine
Mitchell County,
North Carolina

D
Emerald Matrix
Trinitite Mountain
Mitchell County,
North Carolina

actually made in this locality will not lead to deceptions, which would greatly retard any natural development of interest. It is quite possible that diamonds may be found widely distributed throughout the auriferous belt of the Carolinas and northern Georgia; and that, in the often rude and hurried methods of gold-washing employed, they may have been overlooked in the past, and now lie buried in the piles of sand that stretch for miles along the water-courses.* It is stated that 3 diamond crystals were obtained many years ago on Koko Creek, at the headwaters of the Tellico River, in East Tennessee, on the "Bench lands" of the Smoky or Unaka Mountains. If this statement be correct, it probably points to a western extension of the diamond belt of North Carolina, or to the transportation of the stones thence by streams.*

Franklin County is far removed, both geographically and geologically, from all the other points above noted; and indeed in both aspects, a possible relation is suggested rather with the celebrated Manchester, Virginia, diamond. In both these cases, if the diamonds came from the Blue Ridge, they must have been carried a long distance by streams. There is, however, a possible nearer source, in the belt of "Atlantic" or "Tide-water" gneiss, which runs down from New York to and through the Carolinas, forms the rapids in the James at Richmond, and goes on directly toward Franklin County, North Carolina. This is merely a suggestion, however, caused by the geographical isolation of these two occurrences; nowhere else along this gneissic belt have diamonds ever been found.

* *Gems and Precious Stones of North America*, by Geo. F. Kunz, New York, 1890, p. 21. 8vo, 368 pp.

* *l. c.*, p. 85.

CHAPTER III.

CORUNDUM GEMS.¹

While diamonds and gold are found in the Piedmont country east of the mountains, North Carolina's chief corundum rocks are in Madison, Buncombe, Haywood, Jackson, Macon, and Clay counties, where numerous occurrences are known. A second and a third line of localities are recognized, but they are of slight importance. There are occurrences of corundum, however, east of the mountains, in the counties of Gaston, Lincoln, Burke, Iredell, Guilford, and Forsyth. The late Prof. John A. Humphreys called attention to some of these in 18—, in his paper No. 12 of "Natural History Notes on Western North Carolina," and suggested their possible importance in comparison with those farther west. Some of the earliest specimens, also, were collected in Gaston and Lincoln counties, as will be noted further on. But the main corundum region is beyond the Blue Ridge, where it forms a belt or zone of large extent, stretching along the whole course of the Southern Appalachians. The principal corundum gems are the ruby, sapphire, and oriental emerald.

According to Dr. Thomas M. Chatard,² of the United States Geological Survey, the corundum region extends from the Virginia line through the western part of South Carolina, and across Georgia as far as Dudleyville, Ala. Its greatest width is estimated to be about 100 miles. This belt has sometimes been called the chrysolite or chromiferous series, owing to the presence of chrysolite containing chromite, from the former of which corundum was believed, by certain authorities, to have been derived by alteration.³ In this decomposed and altered chrysolite (dunite) throughout the Southern States, corundum is found in place; and the earlier writers on the subject, including such eminent authorities as Dr. J. Lawrence Smith and Prof. Charles U. Shepard,⁴ believed it to be confined to the serpentinous rocks of this belt, which represent largely an al-

¹ For more detailed descriptions of corundum occurrences in North Carolina, reference is made to Reports, N. C. Geol. Survey, Vol. I, 1905, on Corundum and the Basic Magnesian Rocks of N. C., by Joseph Hyde Pratt and Joseph Volney Lewis; Corundum and the Basic Magnesian Rocks of N. C., by J. Volney Lewis, Bull. No. 11, 1895; and also Gems and Gem Mining in the South, by Joseph Hyde Pratt; The Southland, Vol. I, Nos. 3 and 4, 1901.

² Mineral Resources of the United States, p. 714, 1883-1884.

³ See Corundum: Its Alterations and Associated Minerals, by Frederick A. Genth, in Contributions from the Laboratory of the University of Pennsylvania, No. I, Philadelphia, 1873.

⁴ Corundum and its Gems: A Lecture before the Society of Arts, Boston, 1876.

teration product of chrysolite. Such was the general view during the years following the Civil War, when the mineral resources of North Carolina were beginning to be actively developed.

More recently, it has come to be seen that this is only one phase of corundum occurrence, although much the most conspicuous. The investigation of the Geological Survey, conducted by Dr. Joseph H. Pratt,^a and Prof. Joseph Volney Lewis,^b have traced several distinct associations in which corundum appears. Three of these are clearly developed in North Carolina:—(1) In the crystalline schists, as long prismatic crystals, usually opaque, grey, pink, or blue; (2) in the decomposed chrysolite or peridotite rocks, called dunites, that intersect the schists, as igneous intrusions; the crystals often large and variously colored, but very rarely of gem quality; (3) in more or less decomposed basic rocks, with garnets, in the Cowee Valley in Macon County, where the crystals are small, in six-sided tables or to some extent rhombohedral, sometimes transparent and rich red. These last are the "Cowee rubies." The second group corresponds to the chrysolite or serpentine occurrence noted by the earlier writers; the first has been but recently distinguished with clearness from the second. It appears now, through further researches of Dr. Pratt that under this first head are again included two very different modes of geological occurrence,—one in a hornblende gneiss arising from the alteration of an igneous rock and its foliation by pressure, and the other in a true gneiss varying to a quartz schist, which has resulted from the metamorphism of sedimentary strata. These latter gneisses occur separately, extending along the crest of the Blue Ridge, at an elevation of 3000 to 4000 feet, from Rabun County, Georgia, to Clay County, N. C. The corundum appears in irregular bands in the gneiss, evidently belonging to it, and not in veins or dikes. Dr. Pratt concludes that these were originally aluminous shales, and that in the long process of metamorphism, the alumina may have first separated as bauxite (hydrated oxide), and subsequently formed corundum bands parallel to the planes of lamination.

In all the other cases, the corundum is a product of true igneous action, having either crystallized out from a molten rock directly, or formed at the contact zones of such rock with others which it penetrated, by mutual chemical actions under the influence of great heat. The former is a frequent manner in which corundum exists. The extensive deposits lately made known in Ontario, are in a nepheline-syenite, plainly igneous in

^a Amer. Jour. Sci., Vol. VI, Pt. 4, p. 59, 1898; Vol. X, pp. 295-298, 1900.

^b N. C. Geol. Survey, Bull. 11, 1896 and Vol. I, 1905.

origin, and the gem corundums of Montana are derived from intrusive dikes. The occurrence in crystalline limestone, in northern New Jersey, like that in Burma, is probably of the other type, a result of contact metamorphism, although Messrs. Brown and Judd have advanced a theory for the Burman mines, that attributes even these to an original igneous source.

The whole question of the geology of corundum,—its origin, mode of formation, etc., has been obscure and uncertain for a long time. Many theories have been advanced, only to be modified by subsequent discoveries. Within a few years past, however, important progress has been made; and though much remains to be ascertained, a number of points have gradually been established.

Among these is the fact that corundum, long regarded as a somewhat rare mineral, is really of more frequent occurrence than was formerly supposed; and also that it has been formed under various conditions and in several distinct ways. As already stated above, it is now known to have been produced (1) by crystallizing directly out of igneous rocks; and (2) by various forms of alteration and metamorphism, in both igneous and sedimentary rocks. The first head is further divided into occurrences in basic and in acidic rocks, and again into cases when the alumina was present in excess in the igneous rock itself, as an original constituent (autogenic), and those when it was introduced in pieces of an aluminous shale traversed by the igneous rock and taken up by it in its ascent (allothigenic). All these cases of occurrence have now been fairly identified in the corundum localities in the United States.

The earlier writers generally held that pure alumina (corundum) was a secondary or derivative mineral, formed by the alteration of other species in which it had previously existed in combination, as a silicate. Its close association with the altered peridotite or chrysolite (dunite) belt of the South Atlantic States, has already been referred to, and the belief of some geologists that the corundum was derived from the chrysolite, by various processes of alteration. The late eminent Dr. F. A. Genth, while not committing himself to any positive statement as to the origin of the corundum, developed a remarkable body of facts as to the alteration of corundum itself into various other and associated minerals.⁷ There is not space here to go into any full outline of the course of observation and opinion. This has been very well done by Dr. J. H. Pratt, of the North Carolina Geological Survey, in his recent paper "On the Origin of the Corundum associated with the Peridotites in North Carolina."⁸ In this

⁷ The Alterations of Corundum; Proc. Am. Phil. Soc., XIII, pp. 361-406, 1878.

⁸ Am. Jour. Sci., IV, Vol. VI, No. 31, July, 1898, pp. 49-65.

article he shows how the igneous origin of these peridotites or dunites has come to be gradually established, and the separation of the corundum from them as an original ingredient. In a subsequent and more extended paper on "The Occurrence and Distribution of the Corundum in the United States,"^{*} Dr. Pratt describes all the known localities, and the special features of each.

A full and excellent account of the distribution, the geology, and the history and literature of corundum, with special reference to Georgia, has also been given by Prof. Francis P. King, assistant geologist of that State, in his "Preliminary Report on Corundum Deposits in Georgia."^{**}

The earliest discovery of corundum in the United States was reported in 1819, by Mr. John Dickson, in an article on the mineralogy and geology of the two Carolinas, published in "Silliman's Journal."[†] The crystals which he obtained came from Laurens District, S. C., a locality which has since yielded a considerable amount of both corundum and zircon.

Of corundum in North Carolina, the first recorded account is the statement by Prof. C. D. Smith, who was the assistant State Geologist under Professor Emmons, that it was found in 1846, but he does not say where or by whom. Dr. F. A. Genth reports that a large mass of corundum was obtained in 1847, in Madison (then a part of Buncombe) County, on the French Broad River, 3 miles below Marshall.

This was a dark blue piece, associated with chlorite and margarite. In 1849 or 1850, Prof. Charles U. Shepard received from Gen. Thomas L. Clingman several pounds of a coarse blue sapphire broken from a large crystal "picked up at the base of a mountain on the French Broad River in Madison County, N. C." This is probably the same discovery as that previously noted.

Whether the Indians knew anything of corundum is uncertain. It is too hard for them to have worked it in any way, and it has not been recognized among any of the minerals occasionally found in graves or mounds. As Professor King of Georgia says, it is not unlikely that some of the pink or blue fragments of crystalline corundum found in the gravels of the Southern States may have been noticed and prized as ornaments; but the aborigines certainly made very little use of it otherwise. A curious fact is noted by Professor King, however, in reference to the corundum mine at Track Rock, in Union County, Georgia,—that near the locality is a rock covered with curious carvings, many of them resembling animals tracks, whence the place derives its name.

^{*} U. S. Geol. Survey Bull., No. 180, 98 pp., 1901, and Bull. 269, 175 pp., 1906.

^{**} Geol. Survey of Georgia, Bull. No. 2, 183 pp., 1894.

[†] Am. Jour. Sci., I, Vol. III, p. 4.

Possibly the Indians may have employed fragments of corundum in executing these designs on the rock (?).

This first recognition, far to the west, was soon followed by some on the eastern side of the Blue Ridge. In 1852, Prof. R. T. Brumby, of the College of South Carolina, collected specimens of corundum at Clubb (now Chubb) Mountain, in Gaston County, and placed them in the cabinet of the College, where they still remain, with Professor Brumby's dated labels. They are rough crystals and crystalline masses, of dark blue color, covered with the micaceous alteration-products so frequently present; but they have high interest in being perhaps the first North Carolina specimens to be determined, labeled, and placed in a public collection. About the same time Dr. C. L. Hunter discovered corundum in Gaston County, perhaps at the same locality, and Professor Emmons referred to it in his report on the midland counties of North Carolina in 1853.¹² The Civil War began soon after, putting a stop to further research, and it was not until its close that investigations were resumed.

Rev. C. D. Smith, of Franklin, N. C., who in his former position on the State Geological Survey, had become very familiar with the minerals of the State, now discovered most of the important localities in North Carolina. In 1865 a specimen was brought to him from a point west of the Blue Ridge, which he recognized as corundum; he visited the locality, collected specimens, and announced the occurrence. This was the origin of the mining industry now so valuable. These discoveries led to further exploration, and many localities were found in the same region, which have since been more or less developed.

In 1870, Mr. Smith sketched the corundum belt of North Carolina, as running in a southwesterly course across Macon County, where it strikes the Georgia State line, its general direction coinciding with the trend of the Blue Ridge, until it reaches the head of the Tennessee River, when it suddenly ceases on encountering the Nantahala Mountain (a spur of the Blue Ridge here running due north), to reappear 10 miles to the northwest on Buck Creek, whence it pursues its original course of northeast and southwest across the Chunkygal mountains, where it again enters the Blue Ridge. Later investigation has revealed a more extended belt.

Two of the localities in this region have been much the more prominent,—those at Corundum Hill and Buck Creek.

With the opening of the Culsagee (Cullasagee, or Cullasaja) mine, on Corundum Hill, near Franklin, Macon County, by Mr. C. W. Jenks, in

¹² Amer. Jour. Sci., II, Vol. XV, p. 373, May, 1853.

1871, the first systematic attempt to mine gems within the State was begun. From a scientific point of view the operations were most interesting, but the number of gems found did not warrant permanent operations, for gems only, and after a few years mining for this mineral was for abrasive purposes.

This mine, which includes several openings, is situated on the Culsagee or Sugartown Fork of the Little Tennessee River, 8 or 9 miles above (southeast of) the town of Franklin, the county seat, at an elevation of about 2500 feet above the sea. The Corundum Hill is essentially an outcrop of peridotite (dunite), some 10 acres in area, and rising to a height of between 300 and 400 feet. Most of the openings are along the contact of the dunite with the gneiss or schist through which it rises, and follow "contact veins" of corundum. It has often been called the Jenks mine, also the Culsagee and the Corundum Hill, names derived from the locality and from the name of its first operator, Charles W. Jenks, of Boston, Mass. It was subsequently worked by the Hampden Emery Company, of Chester, Mass., under the direction of Dr. S. F. Lucas, and became known as the Lucas mine. It is now owned by the International Corundum & Emery Co., of New York, which also controls several other less important mines in the same neighborhood.

The other prominent locality was the Buck Creek or Cullakenee (also spelled Cullakeenee and Cullakenish) mine, in Clay County, 20 miles southwest of Franklin. It was opened soon afterwards, and has had a similar history. The outcrop is much more extensive, but less work has been done there.

These mines, especially the first, have been described in various scientific papers and reports. One of the earliest published accounts was given by Prof. C. U. Shepard¹³ in 1872; another was by Mr. Jenks himself, 2 years later, in a paper read before the Geological Society of London. In 1876, Prof. Rossiter W. Raymond read an excellent paper before the American Institute of Mining Engineers¹⁴; in 1883, Dr. Thomas M. Chatard, of the U. S. Geological Survey described it again.¹⁵

Besides these valuable articles, there are no less excellent references in various reports of the State Survey, by Prof. W. C. Kerr, and in articles by Dr. F. A. Genth, who was associated with him in portions of the survey work, and by Dr. J. Lawrence Smith.

Professor Shepard described the dunite rock very well, and recognized it distinctly as an altered form of chrysolite, referring it to the species

¹³ Am. Jour. Sci., II, Vol. IV, Aug.-Sept., 1872.

¹⁴ Trans. Am. Inst. Min. Eng., Chattanooga meeting, May, 1876.

¹⁵ Mineral Resources of the U. S., 1883-1884, p. 714.

known as villarsite. Dr. Raymond fully perceived its character as an igneous intrusion, differing from some other writers on this point, since clearly established. Dr. Chatard describes the Culsagee outcrop as consisting of chrysolite (dunite) mingled with hornblende. The corundum is enclosed among various hydromicaceous minerals, commonly grouped under the term chlorite, between the gneiss and the dunite, from the alteration of which they have evidently been formed. It occurs chiefly in crystalline masses, often of considerable size, and sometimes suitable for gems (Pl. IV, A). At other parts of the mine it is found in small crystals and grains mingled with scales of chlorite, forming what is called the "sand vein." This is so loose and incoherent that it is worked by the hydraulic process; and the small size of such corundum is the saving of much labor in the next process of pulverizing. At Buck Creek the chrysolite rocks cover an area of over 300 acres, and from that point southward the hornblende rocks assume greater proportions, being associated with albite instead of the ordinary feldspar and forming an albitic cyanite rock. There is also found here the beautiful green smaragdite, called by Professor Shepard *chrome-arfvedsonite*, which, with red or pink corundum, forms a beautiful and peculiar rock curiously resembling the eclogite or omphacite rock of Hof, in Bavaria, as Professor Shepard had noted in his early article in 1872.

Both these localities have also been recently described, with maps, in the admirable report of Dr. J. H. Pratt and Prof. J. V. Lewis, elsewhere referred to.¹⁶

The resemblance in the occurrence of the North Carolina corundum to that of Mramorsk in the Ural Mountains, as described by Prof. Gustav Rose of the University of Berlin, has been shown by Professor Genth.¹⁷ There the associated species are serpentine and chlorite schist, sometimes with emery, diaspore, and zoisite, very similar to the chrome serpentine corundum belt of the Southern States. The emery deposits of Asia Minor and the Grecian Archipelago, according to Dr. J. Lawrence Smith,¹⁸ yield that substance in marble or limestone, overlying gneissic rocks; while with it are associated many of the same hydromicaceous and chloritic species that accompany both the New England emery and the southern corundum.

With more particular reference now to the actual gems yielded at these various localities, we may note that they occur in two distinct forms: first, as crystals, of which the usual forms for sapphire are doubly termi-

¹⁶ Corundum and the Peridotites of North Carolina, N. C. Geol. Surv., Vol. I, 1906.

¹⁷ Contributions to the Laboratory of Penn. Univ., No. 1, 1873.

¹⁸ Am. Jour. Sci., II, Vol. X, p. 355, Nov., 1850; and Vol. XII, p. 53, Jan., 1851.



A. TRANSPARENT BLUE AND GREEN SAPPHIRE, NATURAL SIZE, MACON COUNTY, N. C.



B. CORUNDUM, SHOWING ALTERATION, NATURAL SIZE, HAYWOOD COUNTY, N. C.

nated hexagonal pyramids, often barrel-shaped by the occurrence of a number of pyramidal planes of successively greater angle; and second, as nodules of purer and clearer material, in the midst of larger masses of ordinary cleavable corundum. These, when broken or falling out, are sometimes taken for rolled pebbles, which they resemble. This latter, and quite peculiar mode of occurrence is treated of somewhat in the able paper on this mine, read by Prof. Rossiter W. Raymond, in May, 1876, before the American Institute of Mining Engineers, and published in their Transactions.

In regard to the relations of different kinds of corundum, Dr. Pratt says:—"The corundum gem or sapphire localities are usually distinct from corundum localities, although very handsome gems have been found where corundum was mined for abrasive purposes, notably at the Corundum Hill mine."¹⁰

In 1874, Mr. C. W. Jenks read a paper on the occurrence of sapphires and rubies *in situ* in corundum, at the Culsagee mine, before the Geological Society of London; in this brief but important article he described the location and mineralogical character of the mine, and the fact of the presence of portions in the corundum of true gem quality. The paper attracted much interest, and Prof. David Forbes said that great credit was due to Mr. Jenks, and that he had "discovered the actual home" of the true ruby and sapphire, which had never before been really traced to their sources (see Pl. I).

Some years later, a London periodical made the statement that any one who found the sapphire or the ruby in its original matrix would be called the "King of Rubies," and that his fortune would be assured. But such is not always the result to those who deserve it. Mr. Jenks was undoubtedly the original finder of the true corundum or sapphire gems in place, and he obtained from this locality nearly all the fine crystals of the best American collections. One of the most interesting of these is a piece of blue corundum with a white band running across it and a place in the center where a nodule had dropped out. This piece was cut and put back in its place, and the white band can be seen running across both gem and rock. (See colored Pl. 1.) Nearly all the fine gems from Franklin, N. C., were brought to light by Mr. Jenks' mining; but although found in their original matrix, they were of such rare occurrence that it was found unprofitable to mine for them alone. The work was subsequently suspended for some time in consequence of the financial crisis of 1873, but resumed by the Hampden Emery Company.

¹⁰ Corundum in the United States, J. H. Pratt, 1901, p. 10 (Bull. No. 180, U. S. Geol. Survey).

The largest crystal ever found, which is 5 times larger than any other known, is one early discovered by Mr. Jenks and described by Professor Shepard.* It is now in the cabinet at Amherst College; but much injured by the disastrous fire of 1882, which destroyed so many fine specimens of the Shepard collection. It weighed 312 pounds, and measured 22 inches in length, 18 inches in breadth, and 12 inches in thickness. In form it was a steep and somewhat irregular six-sided pyramid, terminated above by a rather uneven basal plane. Its general color is grayish blue.

In addition to these and other notable crystals, many public collections, besides the American Museum of Natural History (which possesses much the finest series), contain numerous cut gems from this mine.

A blue stone of over 1-carat weight is in the United States National Museum at Washington, and a series of fine red and blue crystals have been deposited there by S. F. Lucas. In the collection made by the late Prof. Joseph Leidy, of Philadelphia, and now also in the National Museum, are several gems from the same mine, including a wine-yellow sapphire of $3\frac{1}{4}$ carats (660 milligrams); a violet-blue stone of a little over 1 carat (215 milligrams); and three dark-blue ones weighing respectively about $1\frac{1}{2}$ (320 milligrams); $1\frac{1}{4}$ (250 milligrams); and $\frac{3}{4}$ (145 milligrams) carats each.

In Dr. Spencer's notes on American gems in the British Museum of Natural History, London, is noted a specimen of corundum from Corundum Hill, Macon County, N. C., which consists of a rough hexagonal prism, 26 cm. long and 18 cm. across, of a reddish color.

In a recent report of Prof. J. H. Pratt, State Geologist, he thus refers to gems from this locality:

At the Corundum Hill Mines, Cullasagee, N. C., various shades of gem ruby corundum have been found. Two of the best rubies of good color that have ever been found at this mine are in the collection of Clarence S. Bement, of Philadelphia; there are also a number of fine ones in the United States National Museum at Washington. Many of the smaller crystals of various shades of pink to red are transparent near the outer surface and near their extremities, and from these small gems can be cut, but few that are worth \$100 have been obtained from them.

Probably the finest emerald green colored sapphire in the world came from the Culsagee mine and is now in the Morgan-Bement collection at New York. This is the rarest of all the colors of sapphire or corundum gems, and is known as Oriental emerald. The specimen is a crystal

* Am. Jour. Sci., IV, Aug. and Sept., 1872.

4 x 2 x 1½ inches; part of it is transparent, and several very fine gems could be cut from it, see Plate XII.

Another locality in the same county, interesting, though less prominent, is the Mincey mine on Ellijay (properly *Elegée*) Creek, about 2½ miles northeast of Corundum Hill. Some good ruby corundum occurs here, together with a peculiar brown or bronze variety, known locally as "pearl corundum," which shows distinct asterism, both by natural and artificial light, when the stone is cut *en cabochon*. In natural light these corundums all show a bronze luster and are somewhat similar to the cat's-eye, but in artificial light the star is more distinct. Most of the bronze corundum is in rough crystals, but some have been found that have the prismatic faces smooth and well developed, and these are often dark, almost black, in color. One crystal of this dark kind, found some years ago, yielded gems ⅔ of an inch in diameter. A similar asterism has been noticed in many of the rubies and sapphires from Cowee Valley, and at several other points in the State. According to Von Lasaulx, it is sometimes produced by rifts due to the basal parting. These rifts when examined with the microscope, are seen to be very thin, sharp and rectilinear, and are parallel to the edge between the prism and the base. In other cases asterism is undoubtedly due to rutile or other minute crystals enclosed in the corundum, intersecting each other at an angle of 60°, or in some similar systematic positions.

At the Cullakenee mine, Buck Creek, in Clay County, masses of emerald to grass-green amphibolite (also called smaragdite) are found, through which are disseminated particles of pink and ruby corundum, from the size of a pea to some as large as hickory nuts. The corundum is not of gem quality, but the combination of the green and pink makes very beautiful specimens, and as the rock is hard enough to take a good polish, it might furnish a decorative or ornamental stone of some value. It has been introduced for such purposes under the name of ruby matrix.

A similar association of green amphibolite with corundum, sometimes pink and sometimes dark blue, is found near Elf post-office, on Shooting Creek, in the same county. Other corundum localities in Clay County are the Foster mine, near the headwaters of the north fork of Shooting Creek, and the Herbert mine on Little Buck Creek.

Of late much attention has been aroused by the discovery of rich ruby corundum in small distinct crystals of a different character from any others found in the State, and in a different rock. These have been known as the Cowee rubies, from the locality in the Cowee valley, in Macon County. It has seemed as though here, at last, true gem rubies, equal to those of Burma, had been really found, and much interest has been felt in

the discovery. Thus far, however, no very important results have been obtained, although some of the stones are unquestionably fine, but most of them are small (see Pl. I).

They are unusually interesting and beautiful as crystals, but many of them are imperfect. It is claimed, however, that the percentage of imperfect stones is no greater than it is in the rubies from Burma. Unfortunately, many of the crystals also have inclusions which mar their elegance as gems. The exact locality of this very interesting occurrence is a tract of some 10 square miles lying between Mason's Branch and the Caler Fork of Cowee Creek, affluents of the Little Tennessee River some 6 miles below Franklin, Macon County. Many interesting minerals are found in this area, and there are mica mines there, and mines where the abundant garnet has been worked for use as an abrasive. The beautiful rhodolite garnets, found in close association with the ruby crystals in the gravel and saprolite, will be described separately under garnet.

The discovery and development of the "Cowee rubies" were first described in the volumes of the U. S. Geological Survey (Mineral Resources of the United States), in the writer's annual reports on the Production of Precious Stones, from 1893 to 1896, year by year, and further in that of 1899.²¹ Also in 1899, there appeared a full account by Prof. J. W. Judd, Mr. W. E. Hidden, and Dr. J. H. Pratt²²; and the latter gentleman has since published further accounts in his annual reports, and in his special bulletins on corundum in the United States.²³

The first published notice in the author's report for 1893, above mentioned, was of the finding of ruby corundum, in small hexagonal crystals, flat or tabular, in an alluvial deposit on the Reeves farm, not far from Franklin, associated with beautiful garnets. The next year's report described the locality as consisting of the valley of a stream, for several miles, in which the rubies were distributed through a gravel bed from 2 to 10 feet thick, overlain by several feet of surface deposit,—a mode of occurrence very similar to that in the Mogok Valley in Burma, where the finest rubies are obtained.

The attention of the author was first called to these rubies by the late Mr. James D. Yerrington, of New York, who had specimens, both cut and uncut, that he had received from Mr. Reeves, of Athens, Georgia, who owned the farm on which they had been found. Two cut gems of $\frac{1}{2}$ a carat each, were set in a flag scarf-pin shown in the Tiffany jewelry

²¹ Mineral Resources U. S., Ann. Reps. U. S. G. S., 1893, 1894, 1895, 1896, 1899.

²² Am. Jour. Sci., IV, Vol. VIII, Nov. 1899, pp. 370-380.

²³ Bulls. U. S. Geol. Survey, No. 180, 1901 and No. 269, 1906.

exhibit at the Columbian Exposition of 1893; these were subsequently unmounted and displayed by the same firm at the Atlanta Exposition of 1895. They now form part of the Tiffany-Lea collection, included in that of the U. S. National Museum at Washington. A number of others (see figures), obtained at about the same time, are in the American Museum of Natural History, New York. A fine series, both of crystals and cut gems, was shown by the North Carolina Geological Survey at the recent Expositions at Buffalo, 1901, Charleston, 1901-02, and St. Louis, 1904.

In 1896, the locality was visited and examined by Mr. C. Barrington Brown, the eminent authority on ruby mining, who had previously prepared an exhaustive report on the Burma region, in conjunction with Prof. J. W. Judd, for the British Government.

In 1899, as above stated, Professor Judd and Mr. William E. Hidden published a joint article, with crystallographic notes by Dr. J. H. Pratt. This account embodied the results of Mr. Brown's visit, of Mr. Hidden's operations on the ground, and of Dr. Pratt's studies on the crystal forms and their relations. It had now become clear that the rubies from this locality occurred in a wholly different association from any other corundum in the State, and the title of the article was "On a New Mode of Occurrence of Ruby in North Carolina." The surrounding rocks are schists and gneisses, often containing corundum, but in elongated crystals and not of gem quality. Only a few miles away are the dunite outcrops of the Culsagee and other localities, already described. But at Cowee the rock is wholly different, and the forms of the crystals also. The first accounts had reported a limestone as the probable source of the valley deposit, and even as the matrix of the crystals, as is the case in Burma. But further study had disproved this statement. Underneath the ruby-bearing gravel, comes a soft decayed rock to which the name of saprolite has been given,—a result of the decomposition of basic igneous rocks, in place. This is sometimes many feet in thickness, but gradually passes downward into the unaltered condition of the same rocks. Trial shafts show that this change begins from a depth of some 35 feet, when portions of the unaltered rock begin to be met with. The original rock, when reached, proves to consist of several related varieties, comprising amphibolite, hornblende-eclogite (garnet-amphibolite of some authors), and a basic hornblende-gneiss, with some feldspars (labradorite and perhaps anorthite). Some of these rocks are doubtless the source of the rubies strewn through the saprolitic material and the overlying gravel, though their actual occurrence in the undecomposed rock has not yet been proved. The crystals are distinct from any others found in North Carolina, but

resemble in form those from Yogo Gulch, Montana (the sapphire variety) which are taken from true igneous dikes; and these flat and tabular hexagonal forms are regarded by students of crystallography as characteristic of corundum that has solidified from a molten igneous rock.

Another corundum occurrence in saprolitic rock, but the crystals blue and more prismatic, is noted by Dr. Pratt at the Reed, or Watauga mine, 6 miles east of Franklin; and red, sometimes ruby, corundum is found in old stream gravels near West Mills; both of these are in Macon County. A number of minor occurrences are known throughout the general region, where there are small saprolitic areas.

There are many other localities of corundum in this group of counties, some of the more important or promising of which may be simply mentioned here. In Macon County, besides the important occurrences already described, corundum appears at Glenville, in chlorite schist; at Nona, on Thumping Creek, in nodules and flat crystals in gneiss; on Hickory Knoll Creek at an elevation of 4,000 feet on Fishhawk Mountain, in dunite; and at the Coweeta mine, of pink color in greenish cyanite. Of late, the emery variety has been found, and to some extent worked, at several points near Fairview Knob, in a basic magnesian rock, the principal mine being the Fairview, near North Skeener Gap, and the Waldroop mine on Dobson Mountain.

Jackson and Transylvania counties have numerous corundum localities, notably in the region along their border, where the town of Sapphire has been named, and the appellation of the Sapphire country is frequently used. Here are found many outcrops of peridotite, with a general N.E.-S.W. course, and frequently associated with corundum. One locality that gives some promise is the so-called gem mine on the property of Dr. Grimshawe, of Montvale. This has been known and to some extent worked, for many years. Rubies of good color, from which a number of fine but very small stones have been cut, have been found here in the gravels of the stream, together with blue and yellow corundum of gem quality. By following up the gravels the corundum was located in a small vein in the decomposed peridotite.

At the Sapphire and Whitewater mines, near Sapphire, fragments of corundum of a fine blue color have been found, from which small but good gems have been cut.

Quite large amounts of commercial corundum have been taken out at the Bad Creek and Socrates mines, and also at the Burnt Rock and Brockton mines; these two are in Transylvania County, the others being in Jackson County, and all in peridotite. Other associations in Jackson County are, along Caney Fork and Chastain's Creek, in chlorite schist; and at Bett's Gap in translucent grayish-white crystals in gneiss.

In Haywood County, 2 miles northeast of Pigeon river, near the crossing of the Asheville road, and 2 miles north of this, on the west fork of Pigeon River, at Presley mine, are found some of the finest colored specimens of blue and grayish-blue corundum, in a pegmatitic dike, and also near Retreat post-office (see Pl. IV, B). At Newfound Gap, red corundum occurs in an outcrop of dunite.

Twenty miles northeast of the Presley is the Carter mine in Buncombe County, where fine white and pink corundum occurs in crystals and in a laminated form in peridotite. Blue, bluish-white, and reddish varieties occur at Swannanoa Gap; and also a little south of the town of Democrat, corundum appears,—all in the same or similar rock.

Yancey County has several localities, the most noted of which are Celos Ridge, 8 miles southeast of Burnsville, where crystals occur in a decomposed gneiss, and Egypt, 10 miles west of the same town, where white crystals, sometimes mottled with blue, are found directly in the decomposed peridotite (dunite). This occurrence is noted as of much interest, by Lewis¹ and Pratt,² for although corundum is very largely associated with the rock, the crystals are rarely found actually enclosed in it.

Northeast of these mines, in the line of strike of the whole country rock, corundum is found in gneiss near Bakersville, in Mitchell County; and also southwest, in Madison County, near Marshall, a little north of where Big Ivy River enters the French Broad; here the rock is amphibolite.

Grouped together under the name of the Blue Ridge tract, are a number of localities where the corundum occurs in long bands of quartzose schist that belong in and with the gneisses among which they occur. This was referred to before as a very distinct mode of occurrence, in that the rocks are altered sediments, and the corundum, a product of metamorphic action rather than igneous. These corundiferous schists have been traced for many miles along the crest of the Yellow and Chunkygal mountains. The content of corundum is very small, and these deposits will not be important sources for some time to come. Dr. Pratt makes 4 local divisions;—The Scaly Mountain tract, at an elevation of some 4,500 feet on the southern and southwestern slopes of those mountains, near the headwaters of Beech Creek, a tributary of the Tallulah; the Foster tract, just over the line in Georgia; the Yellow Mountain tract, on the northern slopes of those mountains; and the Chunkygal tract, near the headwaters of Sugar Cove Creek, on the western slopes of the mountains. The first

¹ Bull. 11, N. C. Geological Survey.

² Bull. 269, U. S. Geological Survey.

two have been worked somewhat, by the Corundum Mining & Manufacturing Co., of Philadelphia. These localities are all near the southern border of the State, and pass over into Rabun County, Georgia.

The Piedmont Counties.—As was stated above, corundum was early found at some points east of the mountains; and the references to discoveries and collecting by Dr. C. L. Hunter, Prof. J. A. Humphreys, and Prof. Brumby of Columbia, S. C., antedate the Civil War by about 10 years. Since the new epoch of mineral development set in after the return of peace, further discoveries have been made, all of interest, but none as yet of importance. Mr. J. A. D. Stephenson obtained fine hexagonal prisms of pale brown corundum at Belt's Ridge, near Statesville, Iredell Co., and some crystals of fine colors from other neighboring points. Prof. Lewis mentions a black corundum in amphibolite, on the Hunter farm, 8 miles north of Statesville, another occurrence in the same rock, at the Acme mine, and a pink corundum in cyanite at the Collins mine, both in the same vicinity. An old locality, especially noted by Professor Humphreys, is Shoup's Ford, in Burke Co., where the corundum is associated with fibrolite, which sometimes surrounds or encloses the crystals, forming what Professor Humphreys described as "pods." In Gaston County, blue corundum occurs with quartz and mica, at Crowders Mountain and Chubbs Mountain; the latter is the source of the Brumby specimens in 1852; it was then known properly as *Clubb* Mountain, named from an old resident and Revolutionary patriot.

Corundum in grayish-blue crystals in garnet-bearing schists and gneisses is reported from points along the ridge stretching from Carpenter's Knob, northwest, on the borders of Burke, Catawba, and Cleveland counties.

CHAPTER IV.

GEM MINERALS OF THE PEGMATITIC DIKES.

In the pegmatite veins of North Carolina are found so many minerals of gem value¹ that a short description of these dikes is given here.

These pegmatitic veins are interesting not only from a commercial standpoint on account of the value of the mica obtained, but also from a mineralogical standpoint on account of the variety of minerals that they sometimes contain.

In character these pegmatitic dikes are very similar to a granite and have sometimes been called "coarse granite" and, if we could conceive of the constituents of a granite magnified a hundred times or more, we would have an appearance that is very similar to a pegmatitic dike. The main mineral constituents of these dikes are quartz, feldspar, and muscovite mica in varying proportions, sometimes being nearly equally distributed while in others sometimes one and again another will predominate. Sometimes the feldspar, quartz, and mica have separated out in rather small masses while at other times they have separated out on a larger scale and are more or less crystallized.

The associated minerals that occur in these dikes vary with their occurrence and while in some there is a great variety of them, in others they are very rare. The pegmatitic dikes that are observed in North Carolina have furnished the greatest variety of accessory minerals, 45 having been observed from the different veins, at a number of which over 20 different minerals have been observed. Of these accessory minerals the garnet (either andradite or almandite) is by far the commonest and is often the only accessory mineral observed.

The accessory minerals in these pegmatitic dikes are usually well crystallized and a number of them are gem minerals. The following is a list of the minerals that have been identified in the mica-bearing pegmatitic dikes in North Carolina and they are given approximately according to their relative frequency of occurrence:

Quartz (massive, crystallized and smoky).	Zoisite (var. thulite).
Albite, Feldspar.	Menaccanite.
	Rogersite.

¹ Joseph Hyde Pratt in "The Southland," Asheville, North Carolina, August, 1901, pp. 120-121.



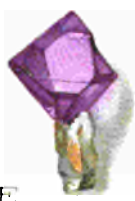
A
Smoky quartz,
(carrigorm stone),
Alexander County, North Carolina



B
Rutilated Quartz,
Alexander County,
North Carolina



C
Rutilated Quartz,
Alexander County,
North Carolina



D E
Amethyst
Henry, Lincoln County,
North Carolina



F
Amethyst,
Tesanty Creek,
Smith Bridge Township,
Macon County, North Carolina



A
Smoky quartz,
(Cairngorm Stone),
Alexander County, North Carolina



B
Rutilated Quartz,
Alexander County,
North Carolina



C
Rutilated Quartz,
Alexander County,
North Carolina



D E
Amethyst
Henry, Lincoln County,
North Carolina



F
Amethyst,
Tessenty Creek,
Smith Bridge Township,
Macon County, North Carolina

The following are commercial minerals:

Graphite.	Muscovite (mica).
Kaolin.	Orthoclase.
Magnetite.	Pyrophyllite.

It is the breaking down of these veins that form many of the smaller often microscopic minerals found in the detritus of the gold veins.

THE FELDSPARS.

Several interesting varieties of feldspar occur in North Carolina, among which the following may be especially noted as the ones which are of importance as gem material.

Orthoclase.—A very interesting variety of sunstone was found by J. A. D. Stephenson at the quarry in Statesville, N. C.; the reflections are as fine as those of the Norwegian, but the spots of color are very small. Several hundred dollars' worth from this locality have been sold as gems.

Microcline.—This feldspar is closely related to orthoclase; it is sometimes of a very beautiful light green color, and is then known as amazon-stone, and valued for cutting and polishing for ornamental purposes. Several localities in North Carolina furnish this mineral, especially the Ray mica mine, Yancey County.

Oligoclase.—In December, 1887, specimens of feldspar were sent to the writer² by Daniel A. Bowman, who had found them at a depth of 380 feet in the Hawk Mica mine, 4 miles east of Bakersville, N. C. They proved to be a variety of oligoclase, remarkable for its transparency. The clearest piece measured 1 by 2 by 3 inches. One of the two varieties is of a faint window-glass green color, and contains a series of cavities, surrounded and fringed by tufts of white, needle-shaped inclusions called microlites; these tufts vary from 1/50 to 3/50 inch (0.5 to 1.5 millimeter) in diameter and are quite round, resembling those that are occasionally present in the Ceylonese moonstone. The wonderful transparency of the oligoclase and the whiteness of the inclusions give the whole mass a striking resemblance to the lumps of glass so commonly obtained from the bottom of a glass-pot. It was mistaken for this until its highly perfect cleavage was noticed. Recently some material of a slightly different character has been obtained at the mine. Cleavage masses of a white, striated oligoclase, 3 inches long, were found containing nodules about $\frac{2}{3}$ inch to $\frac{3}{4}$ inch (10 to 15 millimeters) across, which were as colorless and pellucid as the finest phenacite and entirely free from

² See Mineralogical Notes, by George F. Kunz, Am. Jour. Sci., III, Vol. XXXVI, p. 222, Sept., 1888.

the inclusions found in the greenish variety. This translucent variety, like the other, shows no striae.

The following analysis by Prof. Frank W. Clarke, made from a faint green variety, shows it to be a typical oligoclase. The specific gravity was determined to be 2.651. This has been cut into a transparent gem, and may be advantageously used for spectroscope, microscope, and other lenses.

Silica	62.60
Alumina	23.52
Ferric Oxide .....	.08
Manganous Oxide	trace
Lime	4.47
Potassa .....	.56
Soda	8.62
Loss by ignition.....	.10
	<hr/>
	99.95

Labradorite (Opalescent feldspar).—On the road to Charlotte, Mecklenburg County, and near Bakersville, Mitchell County, specimens showing a slight blue chatoyancy are found. This domestic labradorite is scarcely used at all in the arts, as the mineral from Labrador is cheaper and of a much superior quality, and takes a fine polish.

Leopardite.—This is a rock composed largely of whitish feldspar (orthoclase and plagioclase), spotted black, perhaps by manganese oxide, and named from its leopard-like appearance. It is abundant near Charlotte, Mecklenburg County, and also in Gaston County. It is not a definite mineral, but a variety of porphyry with disseminated crystals of quartz, and occurs in large masses as a rock, so that it would furnish a good ornamental stone, if polished. This variety of spotted feldspar is peculiar to North Carolina, and has been described in detail in the report on Building Stones.

The beryl, zircon, and other gem minerals, which are also constituents of pegmatitic dikes, are described in the following chapters.

CHAPTER V.

QUARTZ AND OPAL.

Quartz in its various crystalline forms,—rock-crystal, amethyst, and smoky quartz,—occurs at many points in North Carolina, and in some cases of fine quality (Pl. V). The non-crystalline varieties, such as agate, jasper, etc., have not, on the other hand, been found to any important extent in the State, until very recently in the chrysoprase workings near Asheville.

CRYSTALLINE VARIETIES.

Rock-Crystal.—Much interest was created in 1886, when a remarkable mass of rock-crystal, weighing 51 pounds, was sent to Tiffany & Company, New York. It purported to be from Cave City, Va., but was subsequently traced with certainty to the mountainous part of Ashe County, N. C.¹ The original crystal, which must have weighed 300 pounds, was unfortunately broken in pieces by the ignorant mountain girl who found it, but the fragment sent to New York was sufficiently large to admit of being cut into slabs 6 inches square and from half an inch to an inch thick. This superb crystal, if it had not been broken, would have furnished an almost perfect ball $4\frac{1}{2}$ or 5 inches in diameter. It is now in the Morgan Collection at the American Museum of Natural History, New York. A visit to the locality by the author traced this specimen to the place of its discovery near Long Shoal Creek, on a spur of Phoenix Mountain in Chestnut Hill Township. There have also been found at 2 places, 600 feet apart (about 1 mile from the former locality), 2 crystals, weighing respectively 285 and 188 pounds. The larger of the 2 was 29 inches long, 18 inches wide, 13 inches thick, showing 1 pyramidal termination entirely perfect and the other less complete. All these crystals were lying in decomposed crystalline rock consisting of a coarse feldspathic granite, and were obtained either by digging or by driving a plow through the soil. Altogether several dozen crystals have been found in this vicinity weighing from 20 to 300 pounds each, and future working will undoubtedly reveal more. These large crystals are often very irregular and pitted, like many of those from St. Gothard. Of those now in

¹ Proc. Am. Assoc'n Adv. Sci., Vol. XXXV, p. 239, 1886.

the Morgan-Tiffany collection at New York, the most irregular was 20½ pounds in weight, with the entire surface rough and opaque like ground glass, and almost spherical in form, but the interior perfectly transparent. In a few instances, they had a coating of rich green chlorite that penetrated to the depth of an inch. This, when left on the quartz, gave the cut crystal, after polishing, the effect of a pool of water with green moss growing on the bottom.

Many beautiful articles have been made from this Ashe County material. One was an elegantly carved vinaigrette or scent-bottle, exhibited at the Paris Exposition of 1889. A crystal ball 5 inches in diameter, and a number of art objects, all of American workmanship, made from the same material, were shown at the Columbian Exposition at Chicago in 1893, and some of these are now in the Tiffany collection in Higginbotham Hall, in the Field Columbian Museum in that city. These were all made in the Tiffany ateliers in New York.

By far the most important piece from this locality, however, was a magnificent crystal obtained in 1888 by the author at the same locality. This was worked up into a special design, and exhibited as the finest piece of American lapidary work ever executed in rock crystal. It was the most important art object of stone at the great Paris Exposition of 1900, where it was shown by the makers, Tiffany & Company. It now will form part of the F. A. Matthiesen memorial gift, lately presented to the Metropolitan Museum of Art in New York City.

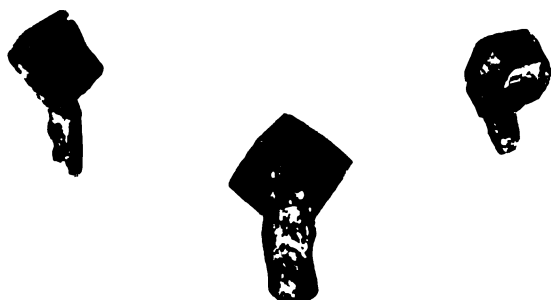
Another North Carolina locality was reported in 1896, by Mr. R. M. Chatham, who described crystals up to 40 pounds in weight, from Elkin, in Surrey County. Some large crystals are also known from South Carolina; and it is probable that a good deal of rock-crystal, capable of use in the arts, exists in the mountain region of the South.

The report of the finding near Bakersville of transparent crystals of quartz, weighing 642 pounds and 340 pounds respectively, was premature, as the specimens proved to be veins of translucent quartzite, with the crystalline markings of a group rather than of a single crystal. The clear spaces, which were to be observed only on these crystalline sides, would hardly afford material for a crystal ball an inch in diameter, and with this exception they are almost an opaque white, with flaws. Notwithstanding this error, it is certain that some localities in North Carolina have yielded larger masses of clear rock-crystal than any other State in the Union until the recent developments in Calaveras County, California.

In Alexander and Burke counties, N. C., crystals of white as well as of smoky quartz have been found, in which were spaces that would cut into



A. QUARTZ CRYSTALS (SMOKY) NATURAL SIZE, ALEXANDER COUNTY, N. C.



B. AMETHYST, LINCOLN COUNTY, N. C.

clear crystal balls of from 2 to $2\frac{1}{2}$ inches (Pl. VII, A). One of these from Alexander County, measuring $2\frac{3}{16}$ inches, is in the State Museum of Natural History at Albany, N. Y. A very interesting bead made of rock-crystal, fluted and drilled from both ends, is in the collection of A. E. Douglas, in New York City. It is evidently native work, as it is improbable that foreign traders would use white rock-crystal beads, when glass would answer the purpose as well.

The Indians who lived in North Carolina previous to the advent of the white man occasionally noticed quartz crystals, as is shown by some being found in the mounds. They also realized the beautiful cutting edge that this material would possess if it were chipped in the form of an arrow point; and so they used up great quantities of the white quartzite for this purpose, and occasionally a transparent piece of quartz, either white or smoky. Many such objects,—of the chase or of war,—made of this beautiful material have been found, and are to be seen in our museums. Within the past 10 years, however, the demand for these transparent arrow-heads has increased, until the demand has so much exceeded the supply that some of the inhabitants, especially in Mitchell County, with remarkable cupidity and cleverness, have chipped arrow-points out of quartz crystals. These are in many ways quite as beautiful as the Indian work, but have no archæological value, of course, though they are to some extent sold as articles of ornament.

The highly modified crystals from White Plains, in Surrey County, and Stony Point, Alexander County, and also from Catawba and Burke counties, N. C., are worthy of note as being crystallographically unequalled anywhere, and as having formed the subject of special memoirs by Dr. Gerhard von Rath² (Pls. VI, A and VIII, A). A beautiful opalescent quartz has been found in Stokes County.

Amethyst (Purple Variety of Quartz.)—An almost unique gem in the collection of the United States National Museum at Washington is a piece of amethyst found at Webster, N. C., and deposited by Dr. H. S. Lucas. The present form is just such as would be made by a lapidary in roughly shaping a stone, preliminary to cutting and polishing it. It was turtle-shaped when found, though the shape was unfortunately destroyed by chipping, and was said to have borne marks of the handiwork of prehistoric man. It now measures $3\frac{3}{8}$ inches (6 centimeters) in width, $1\frac{1}{2}$ inches (4 centimeters) in thickness, and weighs $4\frac{3}{4}$ ounces (135.5 grams). It is perfectly transparent, slightly smoky, and pale at one end, and also has a smoky streak in the center.

² Naturw. Verein, Westphalia, 1888.

In Haywood County a number of crystals of amethyst have been secured, some of which were cut into very fine gems.

In 1894 Mr. T. K. Brunner, of Raleigh, reported a yield of amethysts from Catawba, Macon, Wake, Lincoln, and other counties in the State; and in 1898 he stated that large amethysts of good color were still found in Lincoln County, together with smoky and lighter colored varieties.

In 1901 there was a decidedly promising effort to prosecute mining for amethysts on a commercial scale at Tessentee, on the creek of that name, in Smith Bridge Township, Macon County. Here a large vein of crystalline quartz occurs in an altered pegmatite. The development during the year was entirely in a kaolinized rock, in which the amethyst crystals, ranging from $\frac{1}{2}$ inch to 3 inches in length, were found loose with the quartz and mica in the kaolin. The entire vein was exposed to the depth of 20 feet by a landslide. It would appear that further working should disclose the amethysts in the rock. The crystals are light and dark in color, and the dark spots are often of the deepest purple. No finer amethysts have been discovered in this country, and several thousand dollars worth of crystals were sold as the proceeds of the first development work.

Amethyst crystals, often of great beauty and of much crystallographic interest, have been found in various parts of the State, sometimes in remarkable quartz groupings, such as the so-called capped crystals, with purple tops raised upon slender stilt-like white crystals; others with rare faces, and then again enclosing water, especially from Lincoln County (see Pls. V, VI, B, and VII, B).

Smoky Quartz.—At Taylorsville and Stony Point, North Carolina, a number of clear pieces of this material have been found that cut fair stones weighing over an ounce each. In Alexander, Burke, Catawba, and adjacent counties, smoky quartz crystals which would afford fine gems are frequently met with. They are generally from 1 to 5 inches in diameter, sometimes of a citron or light yellow color, and often in groups weighing up to 100 pounds and over, quaintly grouped and often very clear. Crystals weighing as much as 40 pounds have been taken from the vicinity of Elkin, in Surrey County. Smoky and citrine quartz abound also in Iredell and Mitchell Counties.

At Stony Point, near Hiddenite post-office, Alexander County, N. C., have been found from time to time in the gneissoid rocks, pockets of quartz crystals varying from absolute pellucid and transparent to a dark smoky color. These are of wonderful brilliancy and purity; and range from an inch in length to a large size; but they are particularly remarkable from the fact that the faces of the crystals are highly and peculiarly developed,



A. SMOKY QUARTZ CRYSTALS, 7/16 NATURAL SIZE, HIDDENITE P. O., ALEXANDER COUNTY, N. C.



B. QUARTZ CRYSTALS, WITH AMETHYST TIPS, NATURAL SIZE, LINCOLN COUNTY, N. C.

sometimes with great complexity (Pl. VI, A). They have furnished the subject for several monographs on the crystallography of quartz, notably those by Dr. Gerhard von Rath, of Bonn, and by Dr. Gill, of Cornell University. Some of the large complex groups are very interesting from their remarkable twinning-masses from 150 to 200 pounds, being made up of many crystalline faces, while in general contour a single large crystal. They stand quite unique as examples of beautiful color and marvelous crystallization (see Pls. V and VI, A).

The remarkable smoky crystals with included cavities, from Alexander County, are referred to further on, under quartz inclusions.

Rose Quartz.—Specimens of rose quartz from Dan River, Stokes County, N. C., show a beautiful opalescence, and the existence of like quartz, as well as asteriated quartz, in two other counties, Iredell and Cabarrus, was determined in 1894.

Quartz Inclusions (sagenite).—North Carolina has yielded more of this material for gem purposes than all other American localities together.

Rutilated quartz of unexcelled beauty, the rutile brown, red, golden or black, has been brought to light in many places in Randolph, Catawba, Burke, Iredell, Jackson, and Alexander counties, especially the last, where in 1888 crystals of quartz, 3 inches in length, and filled with rutile the thickness of a pin, were secured at Stony Point (Pl. V). Beautiful series of these formerly in the collection of J. W. Wilcox, of Philadelphia, are now in the Morgan-Bement collection in New York. In 1901, fine rutilated quartz, well crystallized and perfectly transparent, was developed, together with handsome garnets, in the monazite mines near Shelby, Cleveland County.

Hornblende in quartz is reported as found in Burke, Alexander, and Iredell counties.

Mining operations at Stony Point, N. C., have brought to light a number of crystals 4 by 3 inches, and masses of quartz 6 by 3 inches, some of the former filled with what appears to be asbestos or byssolite, forming an interesting and attractive material susceptible of being cut into charms and other objects. Magnificent polished specimens are in the Morgan-Tiffany and Morgan-Bement collections. The inclosures of what is seemingly göthite in minute red, fan-shaped crystalline groups or tufts, form also a beautiful and interesting gem stone.

Among other inclusions, some of which might be utilized for gems, the following may be mentioned from North Carolina: Quartz, including scales of hematite from King's Mills, Iredell County; quartz containing crystals of green spodumene (hiddenite) from Stony Point; inclusions of

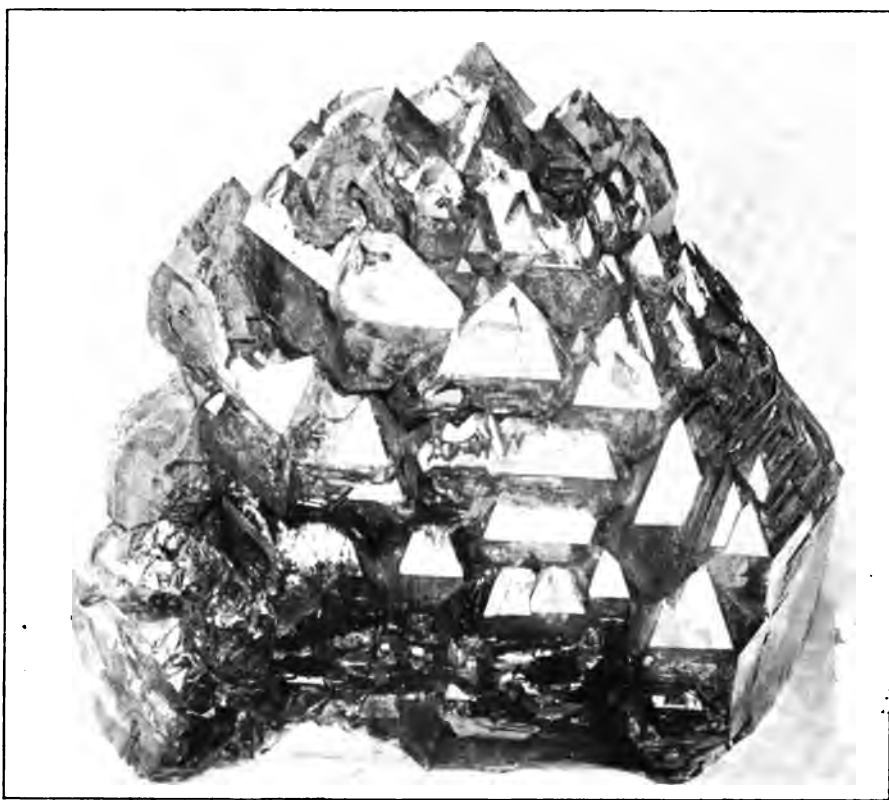
muscovite mica, that are green when viewed through the side of the prism, and of green chlorite, from several other localities in Alexander County.

A remarkable specimen of this kind, that was a "nine-days wonder" some years ago, was the so-called Gibsonville emerald. This was a stone weighing 9 ounces, plowed up near Gibsonville, Guilford County, which was pronounced a genuine emerald by some local expert, who tested it, and with the microscope showed that it contained various small diamonds. Its value was estimated up in the thousands, and \$1000 was reported to have been refused for it by its owner, who, as it was believed to be the largest known emerald, expected that it would bring him a fortune. Being, therefore, too valuable to be entrusted to an express company, he put himself to the expense of a trip to New York, where his prize proved on examination to be a greenish quartz crystal, filled with long hair like crystals of green byssolite or actinolite, on which were series and strings of small liquid-cavities that, glistening in the sun, had led to the included diamond theory. The best offer that he received for the stone was \$5.

Fluid Inclusions.—In March, 1882, Mr. William E. Hidden described and illustrated before the New York Academy of Sciences some unparalleled specimens obtained at Stony Point, Alexander County—the emerald locality elsewhere noted.* Here some 400 pounds of choice large crystals of smoky quartz were taken out of a "pocket" in a quartz vein, besides much of less fine quality. These crystals were filled with cavities containing a clear lustrous fluid, and of extraordinary size, those of an inch long being not uncommon, and some of double that length. The largest was $2\frac{1}{2}$ inches by $\frac{1}{4}$ of an inch. So abundant were they that at times the crystals seemed to be made up of thin walls of quartz, separating a multitude of elongated cavities, parallel to the rhombohedral or prismatic faces of the crystals (Pl. VIII, B).

It is a matter of great regret that such unique specimens could not have been studied with the minute care given by Professors Dana and Penfield to those of Branchville, Conn. But now comes the singular conclusion of this account. The whole body of these crystals, carefully taken out and put aside as great treasures, were shattered into fragments in a single night, by the temperature falling below the freezing point. The contained fluid was evidently, as in the Branchville quartz, principally water, and its expansion in freezing destroyed the entire body of specimens. Those with few cavities exploded with sharp reports, and pieces were blown as much as 15 feet away. Those filled with small cavities were

* On a Phenomenal Pocket of Quartz Crystals; Trans. N. Y. Acad. Sci., March, 1882.



A. GROUP OF QUARTZ CRYSTALS, PARALLEL CRYSTALLIZATION, $\frac{5}{8}$ NATURAL SIZE, LINCOLN CO., N. C.



B. GROUP OF QUARTZ CRYSTALS, ENCLOSING CLAY AND WATER, $\frac{5}{8}$ NATURAL SIZE, BURKE COUNTY, N. C.

reduced to little heaps of fragments frozen together in a coherent mass. All that remained for the illustration of Mr. Hidden's paper before the Academy, were flakes of flat pieces, parallel to the faces of the rhombohedron, and filled and clouded with elongated and often rod-shaped cavities, in great numbers and of conspicuous size.

So-called quartz pseudomorphs after calcite cleavages occur at a locality 2 or 3 miles northeast from Rutherfordton, Rutherford County, and frequently contain irregularly shaped cavities filled with water, which, if broken out in good shape, could be utilized as curious ornaments. This variety of quartz was also found by J. A. D. Stephenson in Iredell County. This occurrence was named and described by Mr. William E. Hidden of New York, and shown to be due simply to quartz filling irregular cavities between the mica crystals in a pegmatite rock. It is known as "box quartz."

NON-CRYSTALLINE QUARTZ.

As was stated above, these varieties have not been very prominent in North Carolina.

Chalcedony.—A rich fawn and salmon colored chalcedony has been obtained near Linville, in Burke County, and fine agates and chalcedony at Caldwell's, Mecklenburg County, near Harrisburg and Concord, Cabarrus County, and in Granville and Orange counties, and at some other localities in the State. A fine green-colored variety intermixed with black hornblende, that would afford gems an inch across, was found some years ago in Macon County, and moss agate near Hillsborough, in Orange County.

Chrysoprase.—This valuable variety of chalcedony, colored green by oxide of nickel, has recently been found in Buncombe County, near Morgan Hill, about 16 miles from Asheville.* It appears in several parallel seams or veins, having a general N.E.-S.W. course, and within a few feet of each other. At the surface, the color was pale green, but as the rock was opened down to some 4 feet, the tint became deeper and richer. Only a little test work has yet been done, and the extent and commercial value of the material cannot at present be determined. The stone polishes very well, and if darker in color the deposit would have considerable value.

Jasper.—In North Carolina fine jasper, banded red and black, is found in Granville and Person counties; bright brick-red and yellow at Knapp's, Reed's Creek, Madison County; at Warm Springs; at Shut-in-Creek in

* Min. Res. U. S., 1902, p. 57 (U. S. G. S. report).

Moore County; also in Wake County, and elsewhere. Black jasper (basanite) also occurs somewhat, and a beautiful spear-point, 5 inches long, and a number of arrow-points, made from this material, have been found near Statesville.

OPAL.

Opal has been found but very sparingly in North Carolina and, with the exception of the hyalite variety, the only specimen that has been found was near Asheville, Buncombe County, and is of a delicate pink color.

Hyalite.—This mineral has been found at the Culsagee Mine, Macon County; the Carter Mine, Madison County; near Concord, Cabarrus County; in Burke County; and in limonite geodes found in the decomposed dunite near Elf on Shooting Creek, Clay County. Nowhere, however, is it of importance, though its presence is of scientific interest.

CHAPTER VI.

BERYL GEMS AND SPODUMENE (HIDDENITE).

BERYL (EMERALD, AQUAMARINE, GOLDEN BERYL).

This gem, chemically a silicate of alumina and glucina (or beryllia) and ranking among the most valuable of precious stones, is found quite extensively in North Carolina. Its commoner variety, beryl, occurs at many places in the State, and sometimes of beautiful gem quality; these are the aquamarines, blue to light green and the yellow or golden beryl. We will first treat of the precious variety, emerald.

Emerald Beryl.—Very few genuine emeralds have been found in the United States; and a number of reported specimens, assumed to be such, have proved upon examination to be only deep green beryls. The true emerald owes its color to a minute amount of oxide of chromium. Some beryls are of a very rich light green, and closely resemble emerald, so that they may easily be regarded as such; but they lack the depth of color so valued in the real emerald (see Pls. III and IX). The chief localities are Alexander and Mitchell counties, N. C., where emeralds, or beryls suggesting them occur. In the former it has been found at several different points, with quartz, rutile (some of the finest known), dolomite, muscovite, garnet, apatite, pyrite, etc., all in fine crystals. One of these places, Stony Point, is about 35 miles southeast of the Blue Ridge, and 16 miles northeast of Statesville, N. C. The surface of the country is rolling, the altitude being about 1000 feet above sea level. The soil, which is not very productive, is generally a red, gravelly clay, resulting from the decomposition of the gneissoid rock, and under these circumstances it is easy to find the sources of minerals discovered on the surface. Prof. Washington C. Kerr's theory of the "frost-drift" is well illustrated by the conditions that prevail throughout this region. The unaltered rock appears at Stony Point at a depth of 26 feet and is unusually hard, especially the walls of the gem-bearing pockets.

An exceptionally clear and reliable account of the search for minerals in Alexander County which resulted in the final uncovering of the important emerald and beryl deposits of Stony Point, has been given by the

developer of the first emerald mine in this country, William E. Hidden,¹ in 1881, and we cannot do better than quote his words. He writes:

Sixteen years ago, the site of the mine now being worked was covered with a dense primitive forest. Less than 10 years ago (1871), this country was mineralogically a blank; nothing was known to exist here having any special value or interest. Whatever we know of it to-day is due directly or indirectly to the earnest field work done here in the past 7 years by J. A. D. Stephenson, a native of the county, now a well-to-do and respected merchant of Statesville, N. C. Under a promise of reward for success, he engaged the farmers for miles around to search carefully over the soil for minerals, Indian relics, etc., and for several years he enjoyed surprising success in thus gathering specimens. The amount and the variety of the material gathered in this way was simply astonishing, and his sanguine expectations were more than realized. To be brief . . . I will state that from a few localities in the county Mr. Stephenson would occasionally procure crystals of beryl of the ordinary kind, but now and then a semi-transparent prism of beryl, having a decided grass-green tint would be brought to him. These the farmers named "green rocks" or "bolts," and became the principal object of the people's searchings. Mr. Stephenson had told them that a dark green beryl would be valuable if clear and perfect, would in fact be the emerald and for them to search more carefully than ever to find one. Surely, he had informed the people aright and had given them a *rara avis* to look for. It is sufficient to say that within a period of about 6 years there was found on 3 plantations in this county, loose in the soil, a number, say 10, of veritable emeralds, none of which, however, were dark-colored or transparent enough for use as gems. All of these specimens went into Mr. Stephenson's collection, with the single exception of one very choice crystal obtained at that locality by the late John T. Humphreys, which crystal is now in the New York State Museum at Albany, after first being in the collection of the late Dr. Eddy, of Providence.

The following historical account is from unpublished notes on North Carolina gems, prepared for the author by Mr. Stephenson himself in 1888:

The first beryl I collected suitable for cutting, was found early in 1875, at the locality now known as the Emerald and Hiddenite mine. It was a beautiful aquamarine, but only partly suitable for cutting. A few weeks later, I obtained at this locality my first emerald; it was small and rather opaque, but of fine color, and the file-like markings on its planes were very distinct. During 1876, I collected two others at the same locality. . . . During 1877, Mr. I. W. Miller brought me 2 emeralds found on his mother's farm, 2 miles northeast of the Emerald and Hiddenite mine. They were of good color and quite transparent, but very rough on the surface. This promising locality is still undeveloped.

¹ The Discovery of Emeralds in North Carolina, by W. E. Hidden. Privately printed, 8vo., 4 p., 1881, and also Trans. N. Y. Acad. Sci., 1882, pp. 101-105.



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1. BERYL (EMERALD), ALEXANDER COUNTY, N. C.
2. BERYL (EMERALD), STONY POINT, N. C.
3. BERYL, ALEXANDER COUNTY, N. C.
4. BERYL (EMERALD) WITH RUTILE, ALEXANDER COUNTY, N. C.
5. BERYL CRYSTALS, GROUP.
6. BERYL (EMERALD) ON QUARTZ, STONY POINT, N. C.

During 1883, Mr. J. O. Lackey brought me 36 small emeralds, found in a vein of dark mica on his farm a short distance southwest of the Emerald and Hiddenite mine. One or two other occurrences in the same region are also reported in these notes.

In July, 1880, Mr. Hidden undertook to follow up the field-work of Mr. Stephenson systematically, by engaging men to dig a series of ditches on a selected site, where at least half a dozen pale beryls had been uncovered by a farmer while plowing. These ditches were dug in different directions, so as to cut the strata of the prevailing country rock (gneiss) at various angles. After this work had been carried on for 5 weeks without success, a so-called "blind vein" or pocket was discovered at a depth of 8 feet. Only a few emeralds, and those of small size, were found in this pocket, but outnumbering the emeralds 50 to 1, emerald-green spodumene was brought to light, which later received the name of hiddenite from Dr. J. Lawrence Smith, of Louisville, Ky., who was the first to determine its true chemical nature (Pl. III). By further work, eleven other like pockets were opened during the year, within an area of 40 feet square, all carrying emeralds in small quantities, and three besides the first containing hiddenite or the spodumene emerald also. Other pockets were found that yielded quartz, rutile, monazite, and mica crystals of great beauty. In others the walls were covered with finely crystallized dolomite and calcite and transparent apatite, as well as the former minerals.

The gem-bearing "pockets" referred to are expansions of quartz veins that traverse the gneiss rock of the region, having generally an east and west course and a dip toward the north. They are usually quite narrow, but on being followed downward, are found to widen out occasionally and form these cavities, which may be several inches wide and a foot or more in length, or in rare cases much larger. There are other quartz veins also, of more irregular course, which do not appear to develop these cavities or yield any of the gems. The gneiss rock decomposes in place to a depth often of many feet; and then the quartz crystals and pieces, the mica and beryls or emeralds, and in short all the harder minerals of the veins and pockets, are left lying in the soil formed by the decayed and disintegrated gneiss. The presence of these minerals on or near the surface, therefore, serves to those who understand their source, as an indication or "sign" of the presence of such veins in the rock beneath. This was the principle, as has been shown, that guided Mr. Stephenson in his pioneer work.

In 1881, a corporation called the Emerald and Hiddenite Mining Company was organized to work the property at Stony Point, and prosecuted

the search for gems irregularly, for periods varying in length, for several years. Since 1885, however, but little has been done, owing to some legal disputes as to the property.

The largest emerald crystal found during this mining work was $8\frac{1}{2}$ inches in length and weighed nearly 9 ounces (Pl. III, p. 8). It is now in the Morgan-Bement collection at New York. This was one of nine crystals contained in a single pocket, all excellent in color and partially transparent, but somewhat flawed. One was 5 inches in length and others were over 3 inches (Pl. III).

One of the most noteworthy gems cut from the product of this mine was from a crystal found in a pocket at a depth of over 43 feet. Its color is a pleasing light green and it weighs $4\frac{23}{32}$ carats. In 1887, at a depth of about 70 feet, another crystal was obtained that yielded a cut stone of 5 carats. Both of these are too light in color to rank as fine gems. The two largest, and a series of the smaller ones, went into the cabinet of Clarence S. Bement, now the Bement-Morgan collection in the American Museum of Natural History. Some fine ones are also in the British Museum. The rich emerald color in many of these crystals is confined to a border from $\frac{2}{100}$ to $\frac{3}{100}$ of an inch in thickness around the edge and near the termination of the crystals. If this edge were thicker, fine gems could be cut from it.

The value of the emeralds in this deposit was relatively small compared with that of the many slender crystals of hiddenite. Both these species are in part silicates of alumina, but they differ in the other basic element present, which, in hiddenite, is lithia, while in the emerald it is glucina. Both gem stones owe their color to the same substance, oxide of chromium. The emeralds found in this mine were very rarely without flaws, while the hiddenite was notably free from such defects, and varied in shade from a yellowish green to the deepest blue-green, often oddly combining both extremes of color in the same crystal.

The chemical composition of the emerald beryl is shown in the analysis given below of a leek-green colored beryl from Alexander County:

*Analysis of Emerald Beryl.*¹

Specific Gravity, 2.703.

Con-stituent.	Per cent.
Silica	66.28
Alumina	18.60
Ferrous oxide	0.22
Beryllia	13.61
Water	0.83
Total	99.54

¹ F. A. Genth, Analyst.

In the soil overlying the rock and resulting from its decomposition, nine crystals of emeralds were found, later, all doubly terminated and measuring from 1 to 3 inches (25 to 77 millimeters) in width. The latter crystal is very perfect as a specimen; it is of fine light green color and weighs $8\frac{1}{2}$ ounces, or only $\frac{1}{4}$ ounce less than the famous Duke of Devonshire emerald crystal (Pl. III). Another crystal measuring $2\frac{1}{2}$ inches (63 millimeters) by $1\frac{1}{12}$ inch (25 millimeters) is filled with large rhombohedral cavities, formerly containing dolomite. As mineral specimens these are quite unique.

Some peculiar features pertaining to the emeralds and beryls from this region, are particularly noted by Mr. Hidden.* "They appear," he says, "as though filed across the prismatic faces." The basal plane is also often pitted with minute depressed hexagonal pyramids, that lie with their edges parallel to one another, and to the edge of the di-hexagonal prism. Rarely, though, crystals are found with perfectly smooth and brilliant faces. The emerald color is often focused on the surface and fades gradually to a colorless central core, which feature is of exceeding interest when the genesis of the mineral is considered." A similar etching or corrosion appears in beryls from Colorado and those from Pala, California. A remarkable fact is that we have here a green beryl (emerald) and emerald green spodumene (hiddenite), and in the Pala, California, mine, we have lilac spodumene (kunzite) and pink beryls.

Some beryls and emeralds of pale color were also collected by Mr. J. A. D. Stephenson, 1 mile southwest of the Stony Point deposit and a short distance from the place where the same mineral was found by Mr. Smeaton, of New York. Such discoveries tend to show that the deposit is evidently not the only one, and that there is still encouragement for future working in this region.

In July, 1894,⁴ a new locality of true emeralds, in the western part of the State, was discovered by Mr. J. L. Rorison, a pioneer miner of mica, and Mr. D. A. Bowman, on the Rorison property, 14 miles from Bakersville, and about the same distance from Mitchell's Peak, Mitchell County. Here, at an elevation of 5000 feet, on Big Crabtree Mountain occurs a vein of pegmatite some 5 feet wide, with well defined walls, in mica-schist. It outcrops for perhaps 100 yards, with a north-and-south strike (Pl. X).

This vein carries a variety of minerals besides its component quartz and feldspar, among these being garnets of a translucent reddish color, and black tourmaline, the latter abundant in slender crystals; beryls, white,

* *Am. Jour. Sci.*, III, Vol. XXXIII, p. 505, June, 1887.

² See Rep. Dept. Mining Statistics, George F. Kunz, 1903.

⁴ 16th Ann. Rep. U. S. Geol. Sur., Part IV, p. 600, 1894.

yellow, and pale green; and the emeralds. These last are chiefly small, 1 to 10 mm. wide by 5 to 25 mm. long, but some have been found two or three times the size of the largest above-named. They are perfect hexagonal prisms, generally well terminated with basal planes, and are of good color, with some promise for gems. They very strikingly resemble the Norwegian emerald from Arendal.

It will be noticed that the occurrence here is entirely different from that in Alexander County, being not in veins of quartz, but in a pegmatite dike. The latter is the usual situation in which beryls are found, from New England to the Carolinas, and also the large deposits of mica suitable for mining. This emerald locality has been lately worked by a New York company, and, although but few perfectly transparent gems have yet been obtained, a beautiful ornamental stone has been developed. The crystals vary from $\frac{1}{2}$ of an inch to $1\frac{1}{4}$ inches in diameter, and are rarely over 1 inch in length. Though not clear, they have rather a fine emerald color, and penetrate the quartz and feldspar in an irregular manner. This green and white mixture is very pleasing; and as the feldspar has a hardness of 6.5, the quartz of 7, and the emerald of about 8, the whole can be cut and polished together. Pieces are cut *en cabochon*, showing sections of one or more emerald crystals on the top and sides of the polished stone. The name of "emerald matrix" is given to this ornamental gem material (see illustration in Morgan-Tiffany collection) (see Pl. III). This property, which was worked quite extensively in 1906 by the American Gem and Pearl Company, of New York, produced some perfectly transparent crystals of emerald which cut good gems up to $\frac{3}{4}$ carat in weight.

Far to the southwest of Stony Point and some 50 miles south of the emerald locality near Bakersville, a second new occurrence was noted in 1897 by Mr. J. Meyer of Charlotte, N. C., who had found near Earle's Station, in that State, between Blacksburg, S. C., and Shelby, N. C., a broken fragment of emerald of good color, better than anything observed from North Carolina, although somewhat flawed; it was cut into a faceted stone, of tapeziform, or sub-triangular shape, weighing $4\frac{15}{16}$ carats, that quite closely resembles the material from the Muzo mine of Colombia.

Aquamarine, Yellow and Golden Beryl.—This mineral, as above stated, is found at many localities in North Carolina, and sometimes of quality fine enough to yield choice gems. It will be noted that beryl localities are met with on both sides of the Blue Ridge, both in the Piedmont region; and west of the mountains. Here again, for the development of these and many other forms of mineral wealth in North Carolina, in the years following the devastation of the Civil War, a lasting debt of honor is due to Mr. J. Adlai D. Stephenson, of Statesville, and also to the late Gen.



EMERALD MINE, CRABTREE MOUNTAIN, MITCHELL COUNTY, N. C., ABOUT 25 MILES FROM MARION.

Thomas L. Clingman, who after serving as a brave officer in the Southern army, turned his energies to the cultivation of the arts of peace and the improvement of the natural resources of his State (see Pls. III, IX, and XI).

Mr. Stephenson published accounts from time to time of his researches and discoveries, beginning soon after the war, and continuing for a number of years. A number of beryl localities are noted by Mr. Stephenson in the counties of Alexander, Burke, Caldwell, Cleveland, Macon, Mitchell, and Yancey, some of them yielding choice material (Pl. IX). The remarkable discovery of emerald beryls at Stony Point, Alexander County, has been already described under emerald; but there are numerous occurrences of beryl in the State, closely resembling those of New England, both in size and variety. Mr. Stephenson called the attention of the author to a dark green beryl, weighing 25.4 ounces, part of which would furnish gems of some size, that was found in January, 1888, near Russell Gap Road, Alexander County, by a farmer plowing. This locality, about 10 miles from Stony Point, is the largest beryl deposit affording gems that has been opened in North Carolina. It is noteworthy that the highly modified beryls of this region occur rarely, and only when associated with spodumene or albite, and also that the white or pale greenish beryls are found with the deepest green spodumene. It has before been noted that the quartz and beryl of Alexander County are more highly modified when implanted on the feldspathic layers of the walls of the pockets. We have here a green spodumene and a green beryl (emerald); we have the same minerals, rose or lilac colored (kunzite) and rose beryl, at Pala, California. Two emerald beryls found in 1881, at a depth of 34 feet, were in a little cavity, the walls of which were almost covered with crystals of albite twinned parallel to the base. Only four emeralds were found, averaging about 1 cm. in the three dimensions. The pocket was free from all decomposition whatever. The crystals were of good color, transparent, and had their commoner planes well polished, but they differed to some extent in habit.

Some of the North Carolina beryls, especially the fibrous, green, opaque beryl from Alexander County, would furnish cat's-eyes, although not very fine.

A rich yellow crystal was reported in 1888 by Mr. Stephenson, as found in a quartz boulder, with finely crystallized tourmaline, near Little River Church, Alexander County. Beryl, resembling the Siberian, occurs in greenish-yellow and deep green crystals, in the South Mountains, 9 miles southwest of Morganton, Burke County; also in the Sugar Mountains at Shoup's Ford, Dietz's, Huffman's, and Hildebrand's. A rich

blue-green crystal in quartz was found at Mill's gold mine, Burke County, and a fine transparent green crystal from that vicinity is now in the cabinet of M. T. Lynde, of Brooklyn, N. Y. Another Piedmont locality is at Wells, in Gaston County.

Some of the beryls from the neighborhood of Statesville are of unusual interest from their crystalline forms; these have been described and in part figured by Mr. W. E. Hidden.*

Passing to the counties west of the Blue Ridge, several good localities are known where fine beryls occur, generally in pegmatite dikes, like the Bakersville emeralds. Clear green beryls have also been obtained at Balsam Gap, Buncombe County; Carter's mine, Madison County; Thorn Mountain, Macon County, and at one or two points in Jackson County. The following, however, are more important:

Blue beryl in fine crystals that afforded fair gems was found near the Yancey County line, and golden beryl in the same vicinity, as noted by Dr. Pratt. Some crystals 2 feet long and 7 inches in diameter, with small clear spots, which would cut into gems, occur 4 miles south of Bakersville, and near Grassy Creek, both in Mitchell County (Pl. III). Fine blue-green aquamarine is known at Ray's mica mine on Hurricane Mt., Yancey County.

The Grassy Creek locality, just noticed, has attracted some attention recently as a source of fine aquamarine. It is situated on Brush Creek Mountain, Estatoe P. O.,[†] Mitchell County. The beryls occur in a pegmatite dike that cuts across the country rock (gneiss) at a low angle, instead of conforming to the steep lamination of the latter, as do the ordinary mica veins. These last are chiefly muscovite, while the dike consists of quartz and albite, with black mica (biotite), garnet, black tourmaline, titanite iron and beryls. Most of the latter are opaque and yellowish, the bright green ones being only occasionally found, and not always in the dike, but sometimes in the adjacent mica-schist,—as though a product of contact alteration. The best crystals have a fine aquamarine tint, and some have yielded very perfect gems of more than a carat in weight. Some honey-yellow beryls also occur, sufficiently clear for cutting, but these are rare.

Another locality in Mitchell County, very promising as a source of aquamarines, is the Wiseman mine at Flatrock, near Spruce Pine P. O. Here the beryls occur not in a dike, as in the last instance, but in connection with veins of muscovite mica that run with the gneiss rock.

* *Am. Jour. Sci.*, Vol. XXII, August, 1881.

† *J. H. Pratt. Jour. Elisha Mitchell Sci. Society*, Vol. XIV, Part 2, 1897, p. 80.



BERYL CRYSTALS, GROUP, NATURAL SIZE, BURNSVILLE, N. C.

Several colors are found here; some are of fine aquamarine tint, and have yielded very perfect gems of more than a carat; less frequently they are honey-yellow, with portions clear enough to be cut; while rich blue ones, equal to any of those from Brazil, have also been obtained in the course of the past 15 years, first by desultory working and then by the most systematic operations under the American Gem Company, of New York City. Large quantities,—thousands even,—of magnificent blue gems weighing from 1 to 20 carats, have been taken out here. (See Pl. II.)

At the Littlefield mine, on Tessentee Creek, Macon County, clear aquamarines have been obtained which have cut into beautiful gems.

At the Charleston Exposition of 1901,¹ Dr. J. H. Pratt exhibited, among other choice minerals of North Carolina, a crystal of golden beryl $1\frac{1}{2}$ inches in diameter and $2\frac{1}{4}$ inches long, obtained from an Indian mound near Tessentee Creek, not far from the Littlefield mine, and hence presumably from that locality. This is the first instance recorded of a beryl crystal found deposited in an Indian grave.

Another important locality in Macon County is the McGee mine. Here the gems are sea-green and occasionally yellow, and are found in quantity.

A fine representation of the North Carolina beryl is to be seen in the museum of the State University at Chapel Hill, together with the other minerals of the State, collected by the late Mr. Stephenson, in the course of his enthusiastic explorations, and whose cabinet was most appropriately secured by the State.

HIDDENITE OR LITHIA EMERALD.

This is a stone which is peculiar to North Carolina, and hence possesses especial interest in any account of the minerals of that State. The circumstances under which it first came into notice have already been mentioned under Emerald, with which it was found, at Stony Point, Alexander County, in about 1879. Mineralogically, it is a variety of spodumene, a well-known silicate of alumina and lithia, usually found in large rather coarse crystals, opaque and of no beauty. Occasionally, however, it is transparent and richly colored (Pl. III). The first occurrence of this form of it in the United States, was in these small brilliant, green crystals in North Carolina; a second has lately attracted much attention in San Diego County, California, where the crystals are large and of a rose-lilac tint; this variety is the new gem-stone called kunzite.

The history of the North Carolina discovery is as follows:

About 1879, some crystals of a yellow and yellowish-green mineral,

¹ Report Dept. Mining. Charleston Exposition, 1901.

supposed to be diopside, were found at Stony Point, Alexander County, N. C., associated with beryl, quartz, rutile, garnet, dolomite, etc. These crystals soon came into the hands of J. A. D. Stephenson of Statesville, who sent the best of them to Norman Spang, of Pittsburg, Pa., a noted collector of choice minerals. About 2 years later Mr. Stephenson called the attention of William E. Hidden to this mineral, and to the locality; Mr. Hidden then sent specimens for examination to Dr. J. Lawrence Smith, of Louisville, Ky., who found, on investigation, that the mineral was not diopside but a transparent variety of spodumene. The crystals were first found loose in the soil with emeralds, but systematic mining revealed them attached to the veins of the wall-rock (Pl. XII, A). The spodumene is generally more or less altered, hence its pitted or eaten-out appearance; but when found in the rock, the crystals are quite perfect and unchanged. They are all transparent and range from colorless (rare), to a light yellow, into yellowish-green, then into deep yellow emerald-green. Sometimes an entire crystal has a uniform green color, but generally one end is yellow and the other green. Its hardness is on the prism faces, 6.5, and across them, according to Doctor Smith, nearly that of the emerald; but a series of experiments proved it to be somewhat less. At first considerable difficulty was experienced in cutting it, owing to its remarkably perfect prismatic cleavage, which is very lustrous. Gems have, however, been cut up to $2\frac{1}{2}$ carats in weight. Specific gravity, 3.18 to 3.194.

Specimens of the crystals and of cut stones, have gone into all important public and private collections in the United States, and to some extent abroad. Dr. Spencer, of the British Museum, has recently described several specimens there contained, in a report to the Director, Dr. Fletcher, as follows:

HIDDENITE: Alexander County, N. C.

A faceted stone of a rich emerald-green color, perfectly transparent, and with only 1 or 2 small cracks. Weight, 0.494 gram.

A piece of matrix bearing 2 or 3 small crystals. Also numerous isolated prismatic crystals up to $2\frac{1}{2}$ centimeters in length; many rather pale in color, but 3 crystals, presented by Mr. Hidden, in 1893, of a rich emerald-green.

The yellow tinge exhibited by this mineral in even the darkest green gems will prevent it from competing with the emerald, since it is this very quality that has kept down the prices of the Siberian demantoids, or Uralian emeralds, as the green garnets are variously termed. The finest crystal of lithia emerald ever found is in the Morgan-Bement collection at New York. (See Pl. III.) It measures $2\frac{3}{4}$ inches (68

millimeters) by $\frac{1}{2}$ inch (14 millimeters) by $\frac{1}{8}$ inch (8 millimeters). One end is of very fine color, and would afford the largest gem yet cut from this mineral, weighing perhaps $5\frac{1}{2}$ carats. In Dr. Augustus Q. Hamlin's cabinet is a fine gem weighing about 2 carats; and a cut stone of fine color, and a good crystal are in the collection of Col. W. A. Roebling. Dr. J. Lawrence Smith^{*} says that the crystals, when cut and polished, resemble the emerald in luster though the color is not so intense as in the finer varieties of the latter gem. Prof. Edward S. Dana says that, owing to its dichroism, it has a peculiar brilliancy which is wanting in the true emerald. Thomas T. Bouvé, of Boston, says: "One might infer from the statement made of the great brilliancy of both the hiddenite and garnet, when compared with the emerald, that this should decide their relative beauty; but it is not the case, for the emerald has a beauty of its own, in its deep and rich shade of color, that will ever make it rank at least an equal in loveliness with the newer aspirants for favor." When the hiddenite was first introduced, it had a considerable sale because of its novelty as an American gem and because of the newspaper notoriety it gained through the controversy that arose as to its discovery. Hence for a time the demand exceeded the supply, which, from the desultory working of the mine, was limited. Thus a $2\frac{1}{2}$ carat stone was sold for \$500.00, and a number of stones brought from \$40.00 to over \$100.00 a carat. The total sale of all the gems found, from the beginning of operations in August, 1880, to the close of 1888, amounted to about \$7500.00, the yield in 1882, during which the preparatory work was done; being about \$2000.00. At the time of the discovery, this was supposed to be the first occurrence of transparent spodumene; but Pisani, in the *Comptes Rendus* for 1877, announced a transparent yellow spodumene that had been found at Minas Geraes, Brazil, where it exists in large quantities and has been extensively sold as chrysoberyl. The writer saw nearly a ton of broken crystals of this mineral at Idar, Germany, in 1881, whither it had been sent for cutting. A stone from Brazil weighing 1 carat is in the United States National Museum, as also a series of crystals and cut stones from North Carolina. At Branchville, Conn., spodumene is found in opaque crystals 4 or 5 feet long and a foot in diameter, almost entirely altered to other minerals. In spots, however, it is transparent enough to furnish small gems of an amethystine color. The alterations which have taken place have entirely changed it to what might almost be called a defunct gem; otherwise, these crystals would have afforded gems

^{*} *Am. Jour. Sci.*, III, Vol. XXI, p. 128, Feb., 1881.

[†] *Proc. Boston Soc. Nat. His.*, Vol. XXIII, p. 2, Jan. 2, 1884.

over an inch in thickness and several inches in length. The color before the alteration was probably much richer pink. It is of mineralogical value only.

Within the past year, the discoveries in San Diego County, California, have brought to light spodumene of a similar color with the little remnants at Branchville, but entirely clear and unaltered.

The North Carolina mineral was given its name by Dr. J. Lawrence Smith (who first determined its true character) in honor of Mr. W. E. Hidden. The crystals are slightly inclined prisms in form, ranging from quite small up to perhaps 2 inches in length and from $\frac{1}{4}$ to $\frac{1}{2}$ of an inch in diameter, for the largest. The first crystal of any size that was found, was shown in the remarkable North Carolina gem-exhibit at the Charleston Exposition of 1901-02. Notwithstanding the interest which attaches to this peculiar and beautiful American gem, no further developments of it have been made for several years, owing to the mines at Stony Point being closed under litigation.

The chemical composition of hiddenite is given in the following table of analyses:

Analyses of Hiddenite.

Specific Gravity, 3.152-3.189.

Constituent.	Per cent. ¹	Per cent. ²
Silica	63.95	64.35
Alumina	26.58	28.10
Ferric Oxide .....	....	0.25
Chromic Oxide	0.18	....
Ferrous Oxide	1.11	....
Lithia	6.82	7.05
Soda	1.54	0.50
Potassa	0.07	....
Water .....	....	0.15

¹ F. A. Genth, analyst, Am. Jour. Sci., III, 23, 68.

² J. Lawrence Smith, analyst, Am. Jour. Sci., III, 21, 128.



A. SPODUMENE (HIDDENITE) IN MATRIX, NATURAL SIZE, STONY POINT, N. C.



B. CYANITE, NATURAL SIZE, BURNSVILLE, N. C.

CHAPTER VII.

GARNET, ZIRCON, RUTILE, AND OCTAHEDRITE.

GARNET.

The name garnet is applied not to any single mineral, but to a well-marked little group, comprising several species and varieties, differing in color and chemical composition, but very closely related physically. They all crystallize in the isometric system, and are all constructed on the same type chemically, though varying considerably in their components. They are silicates of lime, magnesium, iron, or manganese, with more or less of alumina, ferric iron or chromium. According to the presence and the proportions of these substances, the species and varieties are determined. Several members of the garnet group are found in North Carolina, some of the commoner kinds in large quantities, so that they have been mined for use as an abrasive and some of choicer quality that yield beautiful gems.

Of the latter are to be noted the following: Almandine or precious garnet, the iron-alumina variety; pyrope or Bohemian garnet, the magnesia-alumina variety; rhodolite, a peculiar and beautiful garnet intermediate between these two; and spessartite, or manganese-alumina garnet. This last is rare and the only North Carolina occurrence of it is reported by Dr. J. H. Pratt, in beautiful flattened plate-like crystals in mica, near Bakersville, some large enough to cut gems of a carat or more.¹ Very elegant crystals of large size have been found at Amelia Court House, Virginia, in an albite pegmatite. This variety is not red, but of a peculiar rich brown or fulvous tint (Pl. XIII).

Almandite is the most frequent variety, and the one that has been mined for garnet paper and other abrasive purposes, including a so-called "emery," for which tons of it have been crushed. The color is red, of many shades, varying to brownish and purplish reds. The peculiar play of color observed in some of the North Carolina garnets is usually due to inclusions. In Burke, Caldwell, and Catawba counties are found large dodecahedral and trapezohedral almandite crystals coated externally with a brown crust of limonite, the result of superficial alteration, but

¹ *Gems and Precious Stones of North America*, New York, 1890, pp. 79-83.

usually showing a bright and compact interior when broken. They are sometimes as fine in color as the Bohemian garnets, and should find a ready use for watch-jewels and other like purposes. Some crystals have been found weighing 20 pounds each. Although not fine enough for gems, these might be cut into dishes or cups measuring from 3 to 6 inches across, as has been done in India. A very large quantity of these garnets has been found about 8 miles southeast of Morganton, and also near Warlick, in Burke County. Here they have been extensively mined for abrasive use and also near Hall's Station in Jackson County, where garnet wheels are manufactured.

Bohemian or pyrope garnets.—This garnet of good color, that has furnished gems, has been found in the sands of the gold-washings of Burke, McDowell, and Alexander counties. This species has a more blood red tint than the preceding, and is used largely in the garnet jewelry made in Bohemia, whence the name; it is the same also that passes under the name of Cape ruby, from South Africa, and Arizona ruby, from the territory of that name.

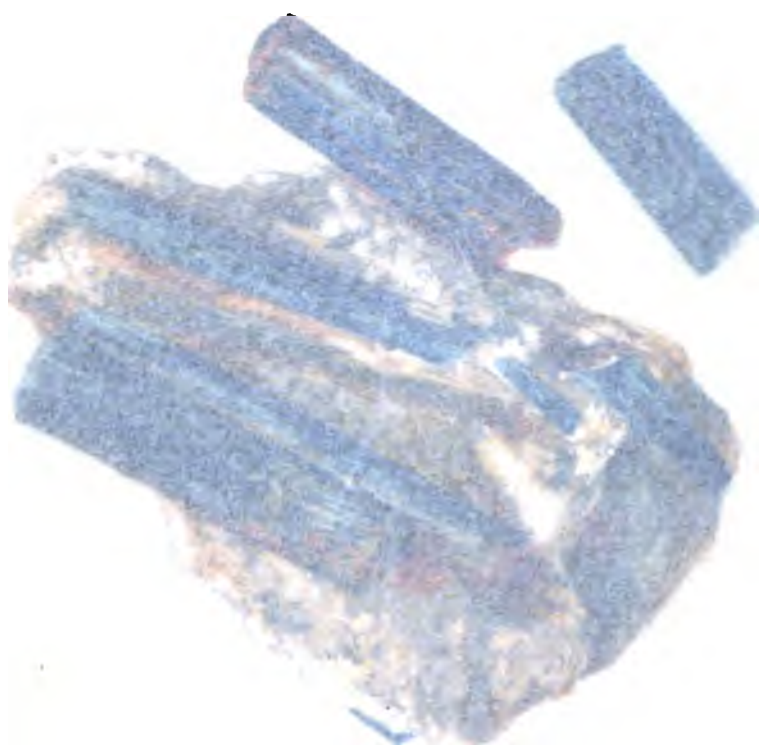
Rhodolite.—This is by far the most important variety of garnet in North Carolina, and is found nowhere else, indeed, so that it possesses peculiar interest. Since it has been recognized and developed, it has proved to be also the most valuable gem produced commercially in the State. The locality is much the same as that of the Cowee rubies, in Macon County, in the gravels of streams heading on Mason's Mountain, and on the mountain itself at some points. When first observed it was regarded as a very beautiful and brilliant light-colored form of almandine; but analysis subsequently showed that it is a variety intermediate between that and pyrope, in fact an inter-mixture of the two, in the proportion of $\frac{2}{3}$ pyrope and $\frac{1}{3}$ almandine.

The first mention of these Macon County garnets was apparently due to Mr. A. M. Field, of Asheville, in 1893,² and was made by the author in his report on the production of precious stones for that year, and again in 1897.³ In the following year, a paper was published by Mr. W. E. Hidden and Dr. J. H. Pratt, in which the whole subject was treated fully, the analyses described, the nature of the stone determined, and the name of rhodolite proposed for it as a new variety.⁴ This name is from the Greek word *rhodon*, a rose, from the resemblance of its color to some kind of roses and rhododendrons. The mineral shows a light shade of fine red, without the dark aspect that belongs to most garnets, and it

² Min. Res. U. S., 1893 (Rep. U. S. Geol. Survey), pp. 15 and 19.

³ Min. Res. U. S., 1897 (Rep. U. S. Geol. Survey), p. 13.

⁴ Am. Jour. Sci., IV, Vol. V, 1898, pp. 293-296; and also Vol. VI, pp. 463-468.



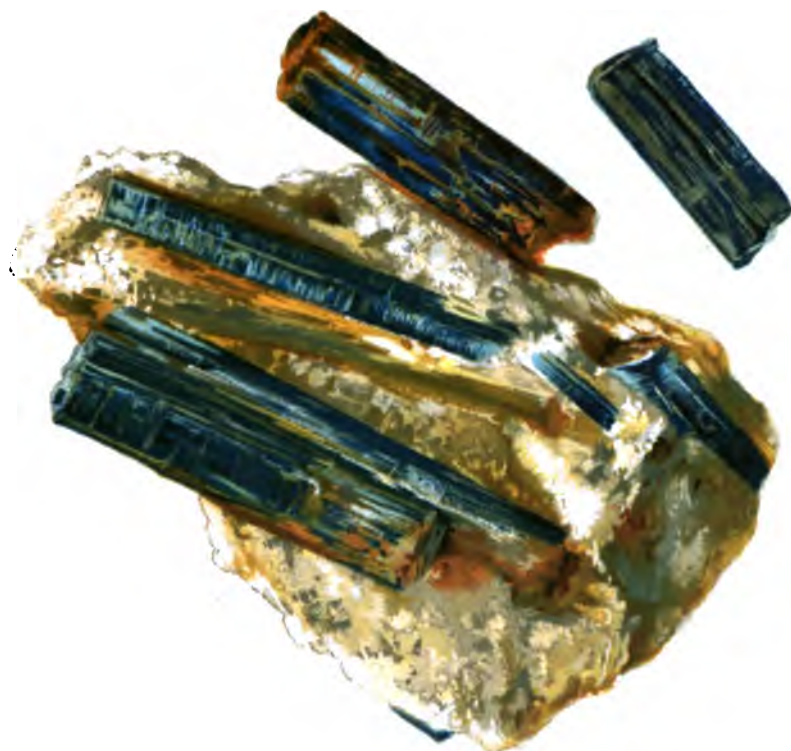
CRYSTALS OF STAUROITE IN SOUTH CAROLINA

Staurolite is a common mineral in the gneisses of the Piedmont region of South Carolina, and is found in many localities. It is a silicate of aluminum, and is characterized by its characteristic six-rayed star-like pattern. Some crystals have been found in the gneisses of the Piedmont region of South Carolina. A very large quantity of these crystals was found in the gneisses of the Piedmont region of South Carolina. A very large quantity of these crystals was found in the gneisses of the Piedmont region of South Carolina. A very large quantity of these crystals was found in the gneisses of the Piedmont region of South Carolina.

The staurolite crystals found in the gneisses of the Piedmont region of South Carolina are of various sizes. Some are very small, while others are very large. The crystals are found in the gneisses of the Piedmont region of South Carolina. The crystals are found in the gneisses of the Piedmont region of South Carolina. The crystals are found in the gneisses of the Piedmont region of South Carolina.

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A
Cyanite,
*Seven Mile Ridge, Mitchell County,
North Carolina*



B
Cyanite,
*Seven Mile Ridge, Mitchell County,
North Carolina*



C
Rhodolite,
*Cowee Valley,
Marion County, North Carolina.*



D
Rhodolite,
*Cowee Valley,
Marion County, North Carolina.*

possesses a remarkable degree of brilliancy, especially in artificial light. Those qualities give it great value for gem purposes, and it has become very popular. The pieces found are not generally large, but stones have been cut of as much as 14 carats. A very fine exhibit of rhodolites was made in the State Geological Survey Exhibit at the recent Expositions at Buffalo, Charleston, and St. Louis. They have been developed by two companies with remarkable success; and apparently more gems in value have been sold from this mine than from all other sources in the State combined. (See Pl. XIII.)

Perhaps \$53,000 worth of these stones have been sold from these mines to date.

ZIRCON.

Zircon (silicate of zirconia) is a mineral of somewhat wide distribution, though rarely conspicuous. It crystallizes in square prisms with pyramidal terminations, generally opaque and of some shade of brown. When transparent, and of any size, beautiful gems can be cut from zircon crystals; these are the hyacinths of jewelers.

In North Carolina zircon is abundant in the gold sands of Polk, Burke, McDowell, Rutherford, and Caldwell counties, and in nearly all the colors found in Ceylon—yellowish-brown, brownish-white, amethystine, pink, and blue. The crystals are beautifully modified, but too minute to be of value. Brown and brownish-yellow crystals, very perfect in form, occur abundantly in Henderson County, N. C., and in equal abundance in Anderson County, S. C. The latter are readily distinguished from the North Carolina crystals, as they are generally larger, often an inch across, and the prism is almost always very small, the crystal frequently being made up of the two pyramids only. They are found in large quantities, loose in the soil, as the result of the decomposition of a feldspathic rock. Large and richly colored zircons, sometimes as much as 2 ounces in weight, and of fine shades of brown and honey-red, are found in Iredell County.*

Within the past 20 years some demand has arisen and continued for minerals containing the rare earths,—zirconia, thoria, etc.,—as these substances are used for the mantles or hoods of the Welsbach and other forms of incandescent gas burners. This demand led to active search throughout the world for the minerals containing these oxides, and so successful has been this search that many species which were once considered rare are now so plentiful that they are quoted at one-tenth to one-

* N. C. Geolog. Survey, Economic Paper, No. 6, 1901, p. 99; and Department of Mining Statistics, 1898, p. 34.

hundredth of their former prices. The best zircon localities in North Carolina are on the Old Meredith Freeman estate, and the Jones estate, Green River, Henderson County. It was leased for 25 years by Gen. Thomas L. Clingman, who, as early as 1869, mined 1000 pounds of zircon, and during that whole period never lost faith in the incandescent properties of zirconia; but when these were finally proved and acknowledged, through some legal difficulties General Clingman had forfeited his leases, and hence failed to reap his reward. The zircon industry has been quite important in North Carolina; and as far back as 1883 Mr. W. E. Hidden mined 26 tons in that single year. The chemical composition of zircon is shown below in the analysis of a sample of this mineral from Buncombe County.

Analysis of Zircon from Buncombe County, N. C.*

Specific Gravity, 4.607.

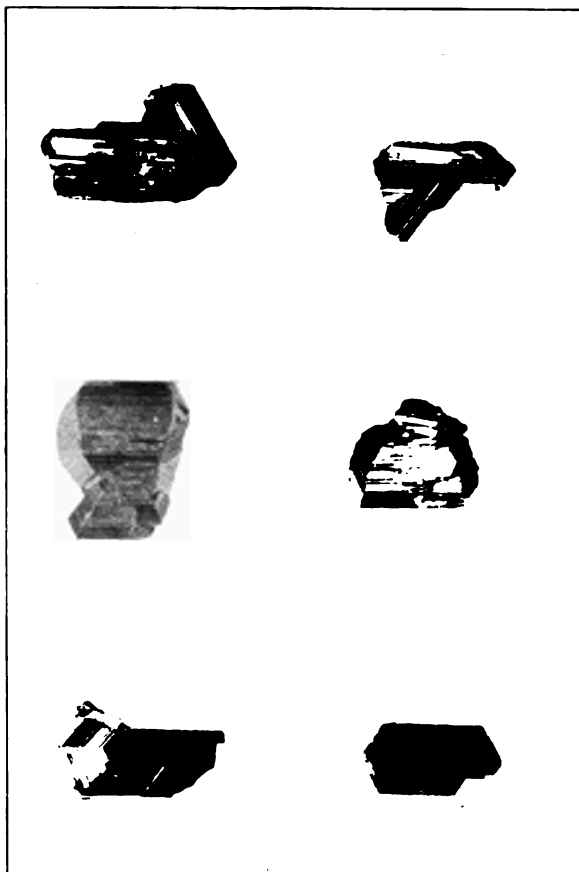
Constituent.	Per cent.	Theoretical per cent.
Silica	33.70	32.80
Zirconia	65.30	67.20
Ferric Oxide	0.67	.....
Water	0.41	.....

RUTILE.

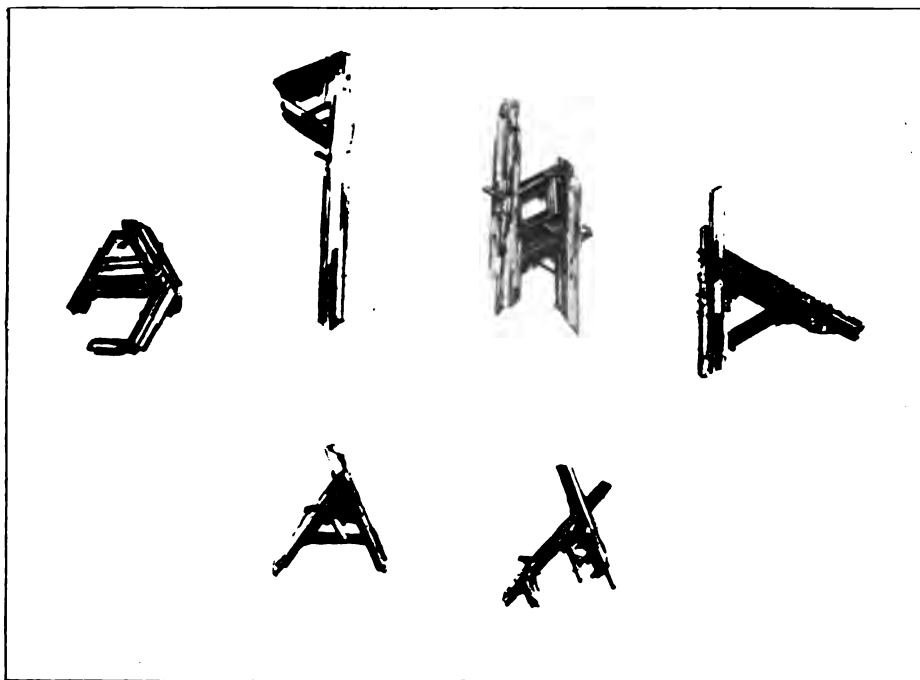
This is one of the most interesting minerals found in North Carolina, although not one that is very conspicuous. In composition, it is pure oxide of the metal titanium, and varies in color from deep red or reddish-brown to black, the crystals being modified square prisms. Specimens from Alexander County rival any that have ever been found for their perfection of form, wonderful polish, and fine color (Pl. XIV, A and B, and Pl. XV). At Graves Mountain, Georgia, elegant rutile occurs with lazulite usually imbedded in a compact red oxide of iron that can be readily removed by hydrochloric acid, or with a sharp instrument, leaving on the surfaces a mirror-like polish. The crystals vary in length from $\frac{1}{2}$ an inch up to 5 inches, and are either single, twins, or vierlings, often in fine groups. The rutile from this locality has realized at least \$20,000 for cabinet specimens, and has supplied the collections of the world through the perseverance of Prof. Charles U. Shepard. It occurs in a similar association with lazulite in North Carolina, at Crowders Mountain, in Gaston County.

The finest small brilliant geniculated crystals are found at Millholland's Mills, White Plains, near Liberty Church, and near Poplar Springs, in

* C. F. Chandler, analyst, Am. Jour. Sci., II, 24, 131.



A. RUTILE CRYSTALS, NATURAL SIZE, STONY POINT, N. C.



B. RUTILE, RETICULATED, NATURAL SIZE, NEAR HIDDENITE P. O., ALEXANDER COUNTY, N. C.

Alexander County, see Plate XIV. These have furnished some of the finest cut black rutile, which more closely approaches the black diamond in appearance than any other gem. Some of the lighter colored ones furnish gems strongly resembling common garnet. Beautiful long crystals at times transparent red, ranging from the thickness of a hair to $\frac{1}{4}$ and in some instances $\frac{3}{8}$ inch across, and from 1 inch to 6 inches in length, often doubly terminated and very brilliant, have been found at Taylorsville, Stony Point, and elsewhere in that vicinity. A very marked form of rutile is that in which these slender red crystals penetrate transparent quartz, both colorless and smoky, forming the beautiful combination called sagenite, or by the French, "flèches d'amour" (love's arrows) (Pl. V). This material is found of remarkably fine quality at several points in North Carolina, and is described in this report under Quartz Inclusions.

Dr. Joseph Hyde Pratt has recently reported the occurrence of beautifully terminated rutile crystals from near Mebane, Orange County. The crystals are up to $1\frac{1}{4}$ inches long and $\frac{1}{2}$ broad and are imbedded in pyrophyllite.

OCTAHEDRITE.

Octahedrite is a rare mineral, identical with rutile in composition, but entirely different in the form of its crystals. It is described by W. E. Hidden¹ as occurring in thin tabular, glassy crystals of a pale-green color and very brilliant up to $\frac{1}{4}$ of an inch in diameter, in the gold sands of Brindletown Creek and elsewhere in Burke and the adjoining counties, especially on the northern slope of Pilot Mountain. These might afford small gems that would compare favorably with the beautiful blue crystals from Brazil, which are so brilliant as to have been mistaken for diamonds. Cassiterite, the oxide of tin, has been found in considerable quantities at King's Mountain. Fine specimens may be cut like rutile, but this place has not yielded a single gem, or been worked as yet with commercial success for tin.

¹ Am. Jour. Sci., III, Vol. XXII, July, 1881, p. 26.

CHAPTER VIII.

CYANITE, EPIDOTE, TOURMALINE, CHRYSOLITE (PERIDOT), SERPENTINE, SMARAGDITE, LAZULITE, MALACHITE, AND PEARLS.

CYANITE.

This mineral (also spelled kyanite) is a subsilicate of alumina almost identical in composition with andalusite, and very closely related also to topaz. It is named from the Greek *kuanos*, blue, in allusion to its prevailing color, and was also called by old writers *sappar*, from a corruption of sapphire, which the fine clear cyanites of deep tint sometimes resemble. It occurs generally in long prismatic or blade-like crystals, and is not uncommon in the gneissic rocks of New England and Southeastern Pennsylvania to North Carolina (Pls. XIII and XII, B). It presents various shades of blue and blue-green, occasionally varying to pure white, —the variety from the Tyrol called *rhœtizite*. Fine crystals occur with lazulite at Clubb's and Crowder's mountains, on the road to Cooper's Gap, in Gaston County, and also in Rutherford County. Cyanite is somewhat frequently associated with corundum, from which Dr. Genth believed it to be derived by alteration. Another locality is at Swannanoa Gap, in Buncombe County; but the finest specimens are found in Mitchell County,¹ where it occurs in distinct isolated crystals that, for perfection, depth of color, and transparency, rival those from St. Gothard, Switzerland. The locality is at an altitude of 5500 feet, near the summit of Yellow Mountain on the road to Marion, 4 miles southeast of Bakersville, in a vein of white massive quartz in a granitic bluff, associated with almandite garnet of a very light transparent pinkish-purple color. The vein has a dip of 60 degrees, bearing northeast and southwest. The color varies from almost colorless to deep azure-blue, as dark as the Ceylonese sapphire, also occasionally green. Some of the crystals are 2 inches long, while a few were observed $\frac{3}{8}$ inch (15 millimeters) in width and $\frac{3}{8}$ inch (10 millimeters) in thickness. Occurring in white quartz, they form beautiful specimens, and the loose crystals were extensively sold for sapphire some years ago, at Roan Mountain, the summer resort. A few

¹ Am. Jour. Sci., III. Vol. XXXVI. p. 224. Sept., 1888.

gems have been cut, and a fine example is in the United States National Museum. It is, however, too soft to admit of much wear.

Another locality of fine cyanite in the same vicinity, was described in 1898 by Dr. J. H. Pratt.^{*} This was on the farm of Mr. T. Young, in Yancey County, on North Toe River, a few miles from Spruce Pine, Mitchell County. Here the cyanite is frequently of a rich mossy green color, sometimes perfectly transparent; and some of the crystals are blue along the center with grass-green margins. Many of them are terminated, which is not common in cyanite; and the locality seems a very promising one.

EPIDOTE.

Prof. Frederick A. Genth mentions^{*} a crystal of epidote in the cabinet of the University of Pennsylvania, from the gold-washings of Rutherford County, N. C. This crystal is strongly pleochroic, like the so-called puschkinite from the auriferous sands of Ekaterinburg, in the Ural Mountains, and would cut into a small gem. Some fine highly complex forms have been observed at Hampton's, Yancey County, by William E. Hidden. These crystals might possibly afford cabinet gems, not equal, however, to the Tyrolese epidote. Handsome prismatic crystals, $1\frac{1}{2}$ inches in length and $\frac{1}{8}$ in diameter, have been reported by Mr. O. H. Blocher, of Old Fort, McDowell County, as found some 40 miles from that place, but with no more specific location. They are brilliant, but of too dark a green to have much promise as gems.

Crocidolite was observed by Joseph Wilcox in long, delicate fibers of a blue color, in one of the western counties of North Carolina.

TOURMALINE.

This is a complex boro-silicate of alumina and several oxides, which is frequent in various crystalline rocks, and in its common black form is found at numerous North Carolina localities. But the richly colored varieties which are valued as gem stones, and are found in Maine, Connecticut, and Southern California, do not appear in North Carolina. The only announcement of the presence of any of them, thus far, was made several years ago by Messrs. D. C. Morgan and Company, of Waynesville, Haywood County, who reported crystals of transparent green tourmaline as found near that place. The colored tourmalines usually contain some lithia, and are nearly always found, when they do occur, in pegmatite dikes. As these latter are frequent in the western counties,

^{*} Am. Jour. Sci., IV, Feb., 1898, pp. 126, 127.

^{*} Minerals and Mineral Localities of North Carolina, Raleigh, p. 44, 1881.

it seems remarkable that almost no tourmalines of this kind have been found in all the mining and prospecting work.

CHRYSLITE (OLIVINE, PERIDOT).

This mineral is a silicate of magnesia and iron. It occurs largely in an altered form in North Carolina, as the leading constituent of the decomposed peridotites called dunites, but very rarely in its unchanged condition. It is a green to yellow mineral, nearly as hard as quartz (6.5-7), and when transparent and in pieces of any size, it is valued as a brilliant gem-stone,—the chrysolite or peridot of jewelers. Near Webster, in Jackson County, it is found in granular masses, of a bright yellow-green color, and susceptible of a fine high polish. This material, if present in any quantity, might be utilized as a pleasing ornamental stone; but not as a gem, unless more transparent and in larger pieces.

Analyses of Chrysolite from Webster, Jackson County, N. C.

Constituent.	Per cent. ⁴	Per cent. ⁵	Per cent. ⁶
Silica	41.89	40.74	41.17
Ferric Oxide }	0.58	1.83	.....
Chromic Oxide }			
Ferrous Oxide	7.39	7.26	7.35
Nickel Oxide	0.35	0.39	0.41
Lime	0.06	0.02	0.04
Magnesia	49.13	49.18	49.16

⁴ F. A. Genth, analyst, Am. Jour. Sci., III, 33, 200.

⁵ I. c.

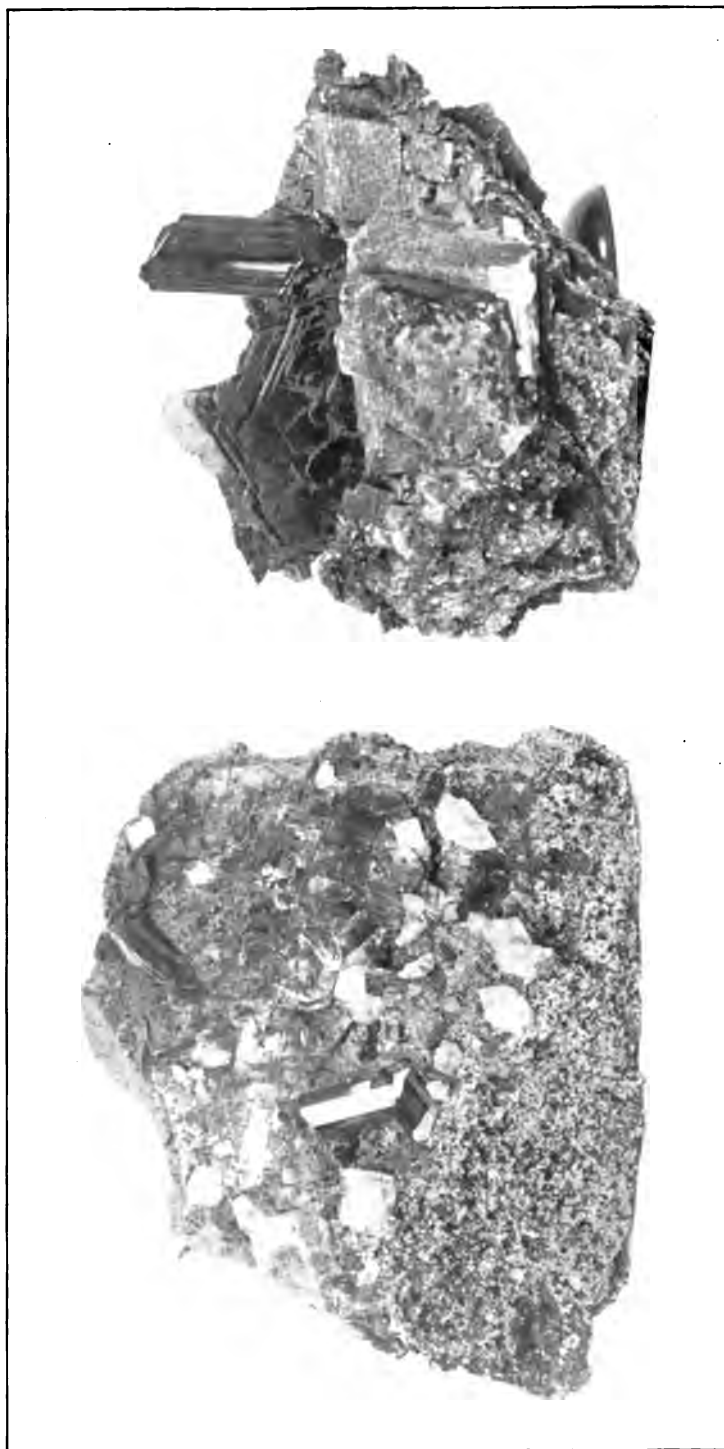
⁶ F. A. Genth, analyst, Am. Jour. Sci., II, 33, 199.

⁴ Color, pale grayish green.

⁵ and ⁶ Color, yellowish olive green.

SERPENTINE.

This mineral, a hydrous silicate of magnesia, occurs widely distributed throughout some portions of the State, and is often a result of the alteration of the olivine-bearing rocks (peridotite, dunite) already repeatedly mentioned. At some points it is massive and of good color and quality, such as might be used for building-stone, as it is frequently near Philadelphia. But the translucent and rich green variety known as precious serpentine, which is used as an ornamental stone like that of Maryland, has been recognized only at a few points and does not appear as yet to have been utilized at all. Dr. Pratt mentions several promising outcrops in Buncombe County, between Leicester and Weaversville, and others in Madison and Yancey counties. Still another, where the serpentine is of fine quality, is in Wilkes County, where it forms the rock of the asbestos



A. RUTILE, WITH DOLOMITE AND MUSCOVITE. B. RUTILE GROUP, NATURAL SIZE, STONY POINT, N. C.

mine near North Wilkesboro. It is hard and compact and polishes handsomely, and might prove as beautiful as that of Harford County, Maryland. Dr. Genth, also, years ago, stated that a serpentine from the neighborhood of Patterson, Caldwell County, of a dark greenish-black color, admits of a fine polish.[†]

Analysis of Serpentine, Webster, N. C.*

Constituent.	Per cent.
Silica	43.87
Alumina	0.31
Ferrous Oxide	7.17
Nickel Oxide	0.27
Magnesia	38.62
Water	9.55

EDENITE (SMARAGDITE.)

Smaragdite is a variety of hornblende (amphibole), which occurs plentifully at the Cullakenee Corundum Mine, Clay County, N. C. In color it is bright emerald to grass-green, also grayish and greenish-gray. Masses through which the pink and ruby corundum occur disseminated, are exceedingly beautiful. The mineral is hard enough to admit of a fine polish and is worthy of attention as an ornamental or decorative stone. It has recently been utilized for such purposes, under the name of "ruby matrix." Pieces are selected in which bright portions of red or pink corundum are enclosed in the rich green smaragdite, and the contrast makes a very attractive material. Smaragdite occurs also near Elf, on Shooting Creek, in the same county, similarly associated with corundum, pink and dark blue.

LAZULITE.

Lazulite is a somewhat rare mineral, a phosphate of alumina containing some magnesia and protoxide of iron. It occurs in pale and dark blue crystals and crystalline masses at Clubb Mountain and Crowder's Mountain, in Gaston County, and at Sauratown, in Stokes County. The finest crystals, however, come from Graves' Mountain, Georgia, some of them being as much as two inches in length. Its hardness is 6, and its specific gravity is 3.122. This mineral would make an opaque gem or an ornamental stone, as the color, though lighter, is often as rich as that of lapis lazuli, for which it was mistaken when first found.

[†] Mineral of N. C., p. 57.

* F. A. Genth, analyst, Am. Jour. Sci., II, 33, 201.

Analysis of Blue Lazulite from Gaston County, N. C.*

Constituent.	Per cent.	Per cent.
Phosphoric Acid	43.38	44.15
Alumina	31.22	32.17
Ferrous Oxide	8.29	8.05
Magnesia	10.06	10.02
Silica	1.07	1.07
Water	5.68	5.50
Hardness	5.0-6.0	5.0-6.0

MALACHITE.

This beautiful green carbonate of copper, often used as an ornamental stone as well as mined for an ore of the metal, is found somewhat in Guilford, Cabarrus, and Mecklenburg counties. The fibrous variety has been observed at Silver Hill and at Conrad Hill, in Davidson County, and in a number of other localities in North Carolina, but is rarely of any gem value. In the Torrey Collection at the United States Assay Office, in New York City, are a few fine gem pieces of malachite from the Copper Knob mine in Ashe County.

PEARLS.

The Indians of Carolina, Georgia, Florida and Alabama, gathered mussels and conchs, as shown by the numerous refuse piles and shell heaps that abound upon the salt-water creeks. It is not a matter of surprise that the Indians, as they opened these shells, should have carefully watched for pearls, and from the vast numbers examined, should have accumulated a store. If the shores of Carolina, Georgia, and Florida did not afford the larger and more highly prized pearls, it is not impossible that pearls from the islands and lower portions of the Gulf of Mexico, and even from the Pacific coast, may have found their way into the heart of Georgia and Florida and into more northern localities, to be there bartered away for skins and other articles. The replies of Indians to Father Hennepin and others and the presence in remote localities of beads, ornaments, and drinking-cups made of marine shells and conchs, still peculiar to the Gulf of Mexico, confirm the truthfulness of this suggestion.¹⁰

* Analysts, Smith & Brush. Dana, Mineralogy, 5th ed., p. 572.

¹⁰ Ancient Aboriginal Trade in North America, by Charles Rau. Report of the Smithsonian Institution for 1872, Washington, 1873; Gems and Precious Stones of North America, New York, 1890-92; U. S. Commission Fish and Fisheries, 1893-98; Pearls, by Geo. F. Kunz, Charles H. Stevenson, Century Co., New York, 1907.

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